Managing environmental and business risks for sustainable avocado production in Turkey

Koç, Özgün Ezgi

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UNIVERSITY OF ZAGREB

FACULTY OF AGRICULTURE

MANAGING ENVIRONMENTAL AND BUSINESS RISKS FOR SUSTAINABLE AVOCADO PRODUCTION IN TURKEY

GRADUATE THESIS

Özgün Ezgi Koç

Zagreb, September 2021.

UNIVERSITY OF ZAGREB

FACULTY OF AGRICULTURE

Graduate study program:

Environment, agriculture, and resource management

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MANAGING ENVIRONMENTAL AND BUSINESS RISKS FOR SUSTAINABLE AVOCADO PRODUCTION IN TURKEY

GRADUATE THESIS

Özgün Ezgi Koç

Mentor: Prof. dr. sc. Mario Njavro

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STUDENT STATEMENT

ABOUT ACADEMIC INTEGRITY

I, **Özgün Ezgi Koç**, JMBAG 0178122945, born on 27 September 1990 in Ankara, Turkey, declare that I have independently written the thesis entitled:

MANAGING ENVIRONMENTAL AND BUSINESS RISKS FOR SUSTAINABLE AVOCADO PRODUCTION IN TURKEY

With my signature, I guarantee:

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- that all literature references, published or unpublished, are adequately cited or paraphrased, and listed at the end of this paper.
- that this thesis does not contain parts of other papers submitted at the Faculty of Agriculture or other higher education institutes, for the reason of completing studies.
- that the electronic version of this thesis is identical to the printed one approved by the mentor.
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In Zagreb, date _____

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REPORT

ON EVALUATION AND GRADUATE THESIS DEFENSE

Graduate thesis written by **Özgün Ezgi Koç**, JMBAG 0178122945, entitled

MANAGING ENVIRONMENTAL AND BUSINESS RISKS FOR SUSTAINABLE AVOCADO PRODUCTION IN TURKEY

Is defended and evaluated with the grade _____, on _____ .

Committee for thesis evaluation and defense: Signatures:

1. Prof. dr. sc. Mario Njavro mentor _____
2. Prof. dr. sc. Ramona Franić member _____
3. Prof. dr. sc. Gabriel Ondrašek member _____
4. Tajana Čop, MSc of Agribusiness and Rural Development, co-mentor _____

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I also would like to thank my friends who helped me when I got lost. I also appreciate my beloved family for their support in everything. My grandfather, who got involved in the avocado world after my studies and started to consume avocado for the first time in his life at 87 years old, deserves special thanks. Last but not least, I would like to thank my husband because of his standing by me all the time whenever I need him. Without his tremendous support and understanding, it would be impossible to finish my studies.

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ABSTRACT

Of the master's thesis – Özgün Ezgi Koç, entitled

Avocado (*Persia americana*), tropical fruit from North America, has become popular progressively. Its popularity due to its health effects, good promotion opportunities, and social media influence emerged an increased demand for avocado worldwide. The production quantities and harvested area for avocado production have shown parallelism with that demand by rising more than double for the last two decades. This growing production delivered some environmental dimensions in different parts of the world. While Chile suffered from the depletion of water sources due to excessive avocado production, Mexico experienced deforestation due to avocado producers converting forest to avocado orchards. Turkey, which started to produce avocado on the Mediterranean coast in the last three decades, follows the trends regarding increased avocado production. Thus, it is essential to approach environmental and business risks and the economic status of the avocado growers in Turkey. This paper aims a) to determine the economics of avocado production in Turkey, b) to assess environmental and business risks of avocado growers in Turkey, c) to recommend business strategies for farmers and policies to mitigate the detrimental effects of avocado production. Therefore, a purposive sample method was adopted with fifteen interviews, both: face-to-face and via phone call. The most significant risk factors were determined, and risk management strategies were suggested to mitigate them. The economic status of the farmers was better compared to other countries' producers'. The avocado farmers in Turkey are economically powerful and competitive in the world. The highest risks about avocado growing were determined as; high winds, fungi, and sunburn for production; robbery, change of agricultural policies, and lack of information sources for business; supply uncertainty for export; finally, depletion of water sources and deforestation for the environment. The most essential risk management strategies for production risks were windbreak plants, shade-net and latex painting, and agricultural insurance. For the business risks, they were security and safeguarding systems, agricultural insurance, and strengthening farmers' cooperatives. Suggested risk management strategies for the environmental risks were water management, under-tree irrigation, using the technological applications for irrigation, increasing the frequency of controls of Ministry of Agriculture and Forest for the conditions of forests and illegal wells, improving criminal sanctions for illegal deforestation and wells, constitution of sustainability certification schemes.

Key words: Avocado Production, Risk Management, Risk Perception, Environmental Risks, Business Risks

1. INTRODUCTION

1.1. History

Avocado (Persea Americana) is a tropical fruit having its origins in North, South, and Central Americas thousands of years ago (Schaffer et al., 2013). Its name originally was derived from an Aztec word, "ahuacatl" which means "testicles" in the Nahuatl language, possibly due to its shape (Silva & Ledesma, 2014). The earliest archaeological indication of human interaction with avocado dates to 8000-7000 BC, thanks to the cotyledons found in a cave in Tehucán, Mexico (Schaffer et al., 2013).

After the discovery of the Americas, Spanish conquistadors included "avocado" in their notes as one of the indigenous fruits of America. A conquistador first mentioned *aguacate*, the Spanish name of avocado, in his travel journal in 1550. On the other hand, an English merchant called avocado, *alvacata* as a modified version of its Spanish name in 1589 (Zentmyer et al., 1987). A Spanish chronicler Landa, first described avocado in 1590 as ["a very large and cool tree which the Indians call on; it has a fruit-like a courgette of great smoothness that seems to flavor buttery and is of very great maintenance and substance. It has a big seed and delicate rind, and people eat it in slices like melon and with salt"] in his book called "Relación de las cosas de Yucatán" (ME & Arzate-Fernández, 2010). At the end of the 16th century, it was clear that avocado was cultivated from Mexico to Peru. Eventually, like other indigenous fruits of America, it had also been brought to the Old World from the New. A description of an avocado tree in Valencia, Spain was stated in a book published in Antwerp, 1601*(*Popenoe, 1934). In the late 19th century, it has migrated to California afterward; "avocado growing" had been drawn attention in the United States of America (USA). In the USA, the horticulturists established the first commercial avocado orchard in Los Angeles, 1908. In the beginning, avocado production for commercial purposes seemed to be desperate since the avocado contained no sugar when compared to other fruits and general consumer perception of "fruit" was to be sugary and sweet (Shepherd & Bender, 2013).

Despite the hesitations, after establishing the orchards, horticulturists started to look for the best varieties. One variety could survive despite the freeze that destroys most of the trees in 1913.

This variety was called *Fuerte* which means “strong” in Spanish (Shepherd & Bender, 2013). Hass variety was introduced to the market in 1926. It was having a longer-continued harvesting season and a more anticipated yield compared to Fuerte. Hass variety has been accepted quite slowly due to its dark skin color by the consumer who had regarded proper skin color as green. However, Hass variety dominated commercial production by 2012, constituting 94,5 % of grown avocados in California (Shepherd & Bender, 2013). The avocado was first introduced to Turkey in 1970 by Food and Agricultural Organization (FAO). Researchers brought four varieties (Hass, Fuerto, Bacon, and Zutano) of avocado to the Mediterranean coast of Turkey. They aimed to see if it was possible to produce them commercially in Turkey. After 1980, the trials showed that these varieties adapted to the region and showed the characteristics specific to variety (Bayram, 2012a).

Avocado has become more and more popular in the last two decades. Figure 1. 1 indicates that interest regarding avocado in the “Google” search engine has increased by almost 80 % in seventeen years (Google, 2021).

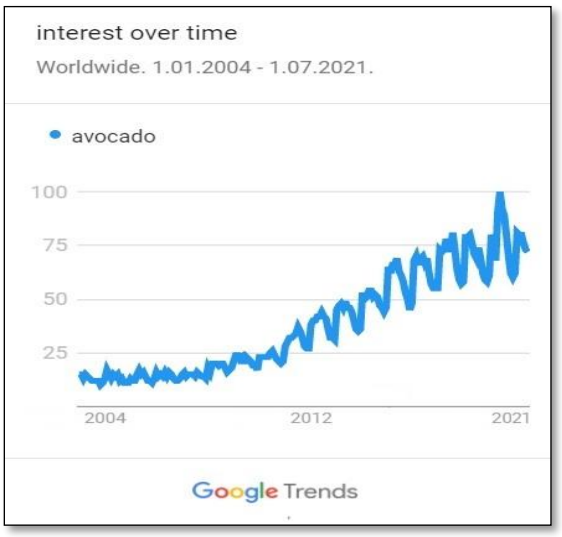


Figure 1.1. Interest over time regarding avocado

Source: Google, 2021-access: 01.07.2021

Consumption of avocado, per unit of population, was around 1.73 pounds during the 1980s and 1.51 pounds during the 1990s in the USA. It reached 8.0 pounds in 2018 with a remarkable increase (Carman, 2019). While fresh avocado use multiplied by 405, 8%, all fruit use increased by 28, 5% between 1990 and 2017 (Carman, 2019). This increasing trend is the same in European countries as well. Table 1.1 indicates the estimated market volume and consumption rate of various European countries. This comparison reveals a significant increase for all countries. The increases in Italy and Germany are even over 100 % (Centre for the Promotion of Imports, 2021).

Table 1.1. Estimated avocado consumption of Europe

	Estimated marketed volume in 2019-2020 (in tons)	**Consumption rate of 2019-20 compared to 2015-16**
France	130,797	27%
United Kingdom	95,054	18%
Germany	89,315	119%
Spain	67,5	19%
Scandinavia (Sweden, Denmark, Norway, Finland)	57,074	13%
Netherlands	40	48%
Italy	23,147	102%

Source: Centre for the Promotion of Imports. (2021). The European market potential for avocados. CBI. https://www.cbi.eu/market-information/fresh-fruit-vegetables/avocados/market-potential. - access 01.07.2021

The main driver behind this enhancing popularity all over the world is the promotion and marketing strategy of "Hass Avocado Board (HAB)" that was founded in 2002 under the leadership of the California Avocado Commission (Shepherd & Bender, 2013). The main objective of HAB was to raise the consumption of Hass avocados in the USA. Their strategy was focusing on more

long-standing demand generation instead of stimulating urgent sales. For this goal, they funded some research projects to be held by some universities regarding potential avocado health benefits such as reducing heart disease risk, stimulating feeling of fullness, and enhancing fat-soluble vitamin absorption in the human body (Shepherd & Bender, 2013). Before those activities, avocado had an image problem due to its high-fat content and not having a specific health benefit. This research focused on the composition and nutrient values of avocado. They enabled the researchers to collect information about the nutrients that avocado contains like, fatty acids, minerals, vitamins, and phytochemicals. After that, avocado reshaped its image and emerged as a nutritious and healthy superfood (Carman, 2019).

Another possible reason for avocado has become mainstream is North American Free Trade Agreement (NAFTA). Canada, the USA, and Mexico signed NAFTA in 1992 to lift or reduce tariffs among these countries (the U.S. Customs and Border Protection, 2014). After this agreement, the USA opened its borders to Mexican avocados in 1997. The USA banned Mexican avocados for 83 years due to phytosanitary problems and competition (Larmer, 2018). In the end, the avocado became all year long accessible fruit in the USA.

The availability of avocado has increased due to technological and agricultural developments. It has become more and more robust against decaying before coming to the people's tables due to post harvest technologies and variety selection. The avocado retailers lead two different marketing strategies to enhance consumer accessibility. The first one is "ripe and ready" that is ready to eat fruit on the shelf or "ripe at home" that is ripened by the consumer at home after buying for 4 or 5 days (Munhuweyi et al., 2020).

People also consume avocado due to its versatility. In lots of trendy diets, people can utilize it as an ingredient. These diets that include "The Atkins Diet" that requires a low amount of carbohydrate. "The DASH Diet" on the other hand, consists of consuming fruit and vegetable-based products. "The Ornish Diet" is a sub-category of "Vegetarian Diet" based on again plant-originated products. Avocado blends well with "The Mediterranean"; "Gluten-free Diet" and "Vegan Diet" as well (Robbins et al., n.d.).

An alternative reason of popularity of avocado is the increasing demand for Mexican cuisine all over the world. “Burittos”, “tacos”, “fajitas” and “quesedillas” are now the main dishes that people may found in every city (Elevate Investments, 2018).

The impact of social media on the rising of the avocado is a different standpoint. In the report of a “social data research company" they defined avocado as a “rising superstar.” According to this report, the avocado was one of the most mentioned super-foods in social media platforms such as Instagram, Facebook, Dailymotion, Twitter, Google Plus, and Youtube when filtered in English between 2016 and 2018 (Linkfluence, 2018). The only product that outperformed avocado was coconut, while “avocado” was mentioned 2,4 million on aforesaid social media channels, “coconut” was mentioned 4,1 million times. It has also become more and more a visual topic. When it comes to “who” are the main actors of these mentions in social media, the first occupation group is personal trainers or coaches, the second one is bloggers, the third one is the chefs followed by dietitians. The “hashtags” that come along with avocado are generally “healthy, healthy food, delicious, breakfast, protein, diet, homemade, fresh.” Most people use avocado for sushi, guacamole sauce, and breakfast options with eggs, toasts, salads, and smoothies. Some famous brands such as Volkswagen and Marks and Spencer even used it to generate engagement with their customers (Linkfluence, 2018).

1.2. Nutrition facts and Health effects

Avocado has a different composition profile when compared to other fruits. On the contrary to most fruits, it is rich in fat and protein and contains very few amounts of sugars (Duarte et al., 2016). The uniqueness of avocado results from its fat-soluble components such as vitamins and unsaturated fatty acids found in the fruit matrix (Duarte et al., 2016). The main health-oriented characteristics of avocado are related to the cardiovascular system, weight management, and healthy aging issues such as; DNA damage protection, osteoarthritis, eye and skin health, and even cancer (Davenport & Dreher, 2013). Figure 1.2 indicates the percentages of nutritional values of a 100 g raw avocado for 86% California and 14% Florida varieties. This chart shows that it is a watery fruit with high-fat content. Regarding its carbohydrates, 80% are fibers, nearly 7% are

sugars (U.S. Department of Agriculture (USDA), 2019b).

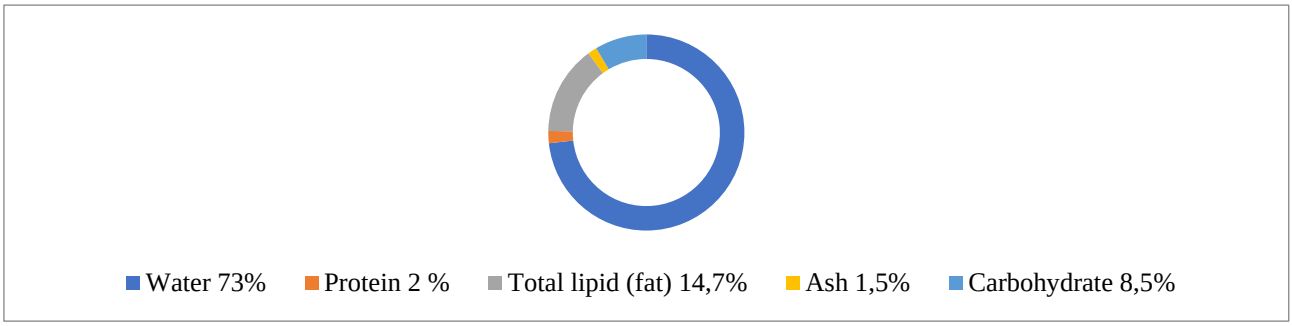


Figure 1.2. Nutritional values for 100 g of avocado, raw

Source: USDA. (2019a). FoodData Central Search Results. FoodData Central. https://fdc.nal.usda.gov/fdc-app.html#/food-details/170379/nutrients. -access 07.07.2021

When it comes to the vitamin content of avocado, it includes a great amount of folate, known as vitamin B9, even more than its equivalent amount of broccoli (USDA,2019a).; counted as one of the good sources of folate (Harvard T.H. Chan School of Public Health, 2019). Furthermore, it has other vitamins in the B group such as Vitamin B1 (thiamine), Vitamin B2 (riboflavin), Vitamin B3 (niacin), Vitamin B5 (pantothenic acid), Vitamin B6, Vitamin B7 (biotin), Vitamin B12 (cobalamin) (Davenport & Dreher, 2013). In addition, it contains vitamin C and vitamin E, A, and K, water-soluble ones (National Academies Press (US), 1989).

The avocado is also rich in minerals such as Potassium (K), Calcium (Ca), Phosphorus (P), Magnesium (Mg), Iron (Fe), Sodium (Na), Zinc (Zn), Copper, (Cu), Manganese (Mn), Selenium (Se), Fluoride(F) *(USDA, 2019b)*. Especially, its K-rich content predominates over other K-rich fruits like bananas *(USDA, 2019c)*.

Avocado has a wealth of mono-unsaturated fatty acids (MUFA) (Davenport & Dreher, 2013), having significant effects on improving lipid profile in the human body (Jenkins et al., 2010). Besides, MUFA affects the reduction in liver fat in type 2 diabetic patients (Bozzetto et al., 2016). Figure *1*.3 indicates that avocado has 71 % of MUFA, even higher than olive fruit in the same amount (Pieterse et al., 2003). The majority of MUFA found in avocado (over 90 %) consists of oleic acid (USDA, 2019b).

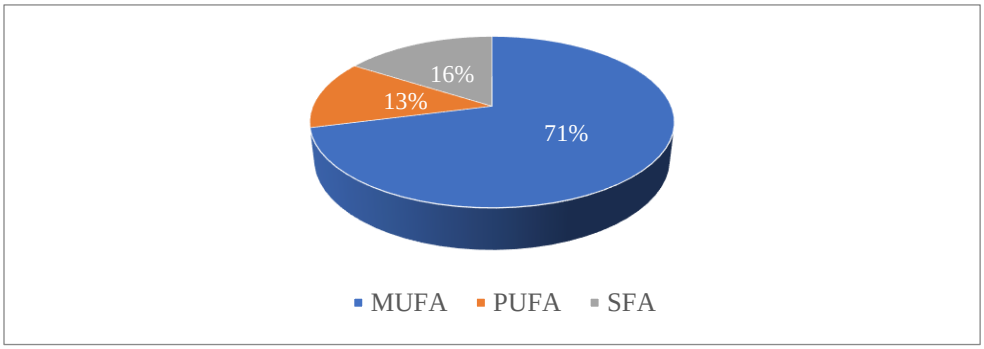


Figure 1.3. Fatty acid composition of avocado (MUFA: mono-unsaturated fatty acids; PUFA:Poly-unsaturated fatty acids; SFA: Saturated fatty acids)

Source: Davenport, A. J., & Dreher, M. L. (2013). Hass Avocado Composition and Potential Health Effects. Taylor & Francis. https://www.tandfonline.com/doi/full/10.1080/10408398.2011.556759 -access: 07.07.2021

In addition to fatty acids, avocado is a good source of phytosterols that are plant-based sterols (Davenport & Dreher, 2013). A meta-analysis based on 124 human studies indicated that phytosterol has a cholesterol-lowering effect that may reduce the risk of cardiovascular diseases (Rouyanne et al., 2014). The main phytosterol in avocado is beta-sitosterol, followed by campesterol and stigmasterol (USDA, 2019b).

The most dominant carotenoids of avocado are xanthophylls named lutein and zeaxanthin (USDA, 2019b). The importance of lutein and zeaxanthin is their function in reducing retinal oxidative damage by absorbing blue light in addition to their antioxidant role (Gopinath, 2016). This way, lutein, and zeaxanthin protect the retina from light-sourced damage (Mares, 2017). Lutein intake is related to improved macular pigment density which is supposed to decrease the risk for macular degradation (Tanumihardjo, 2013). Macular degradation means; central vision destruction that may cause blurred central vision, reduced contrast, abnormalities in the way colors are seen (Mathenge, 2014). Moreover, lutein has inflammatory properties that protect the eye against eye-related pathogens (Mares, 2017).

Gluthanione(GSH) is an antioxidant that all mammals can naturally produce from amino acids glutamate, cysteine, and glycine. However, orally taken GSH can be absorbed by the intestine and oral mucosa. Moreover, the cells in the lungs and epithelium can take up exogenous GSH. Therefore, GSH can protect these cells from oxidative degeneration. Regarding GSH content,

avocado is in third place among 291 foods, including; meat, fruit and vegetable, fish, and milk products, in the list of the National Cancer Institute's Health Habits and History Questionnaire (HHHQ)(Jones et al., 1992). It may detoxicate the carcinogens, modulates immunology, and protect the body from free radicals (Balendiran et al., 2004).

The researchers conducted a considerable number of clinical studies regarding the potential health impacts of avocado. Dreher & Davenport summarized all the clinical research from 1960 to 2005 as a review. Most of them have been related to cholesterol, body weight control and lipid profile impacts of avocado (Davenport & Dreher, 2013)

A randomized cross-over study revealed that people eating the meal with a half avocado inclusion felt more satisfied and a decreased desire to eat by 28% following a 3-to-5-hour period. The high fiber content of avocado improved satiety and mitigated insulin response to meals. In this study, researchers resulted that the inclusion of a half avocado decreased blood insulin levels substantially over a 3-hour postprandial period (Wien et al., 2013).

The clinical trial conducted among overweight people in the USA aimed to measure differences between 4 types of diets. These were the average American diet, low-fat diet, moderate-fat diet, and moderate-fat diet with the inclusion of one Hass avocado. The measured parameter was low-density lipoprotein cholesterol (LDL-C), which is an emerging cardiovascular risk factor. After a 5-week diet, the researchers measured the LDL-C values of each diet. The diet that one avocado included had the most significant decrease in LDL-C followed moderate-fat, low fat, and average American diet (Wang et al., 2015).

Research focused on impact of additional 68 g of avocado to a hamburger on vascular inflammatory and vasodilation. The scholars measured some specific protein levels in the blood that contribute inflammatory pathway. These specific proteins were called IL-6 and IkB-a. For the participants consuming only hamburger, postprandial IL-6 levels raised by 70% over 4 hours but this increase was mitigated when avocado was included. On the other hand, IkB-a protein level is in a reverse correlation with inflammation occurrence. This means, if the IkB-a protein level is law, the inflammation pathway is activated. After the burger without avocado consumed, IkB-a protein levels dropped significantly which activated the inflammation pathway. However, when the participants consumed it with avocado, this protein level was substantially preserved. This

inflammatory pathway is one of the main reasons of *atherosclerosis* which is actually hardening of arteries. One can conclude that, avocado consumption at the side of meat may mitigate vascular inflammation and improve vasodilation (Li et al., 2012).

Researchers investigated avocado consumption's effect on gastrointestinal microbiota among obese adults. This study indicated that avocado consumption improved the number of bacteria in the intestine responsible for fiber fermentation. Furthermore, the bile acid concentrations of the individuals who consumed avocado as a part of their diet had lower values when compared to ones who did not (Thompson et al., 2020).

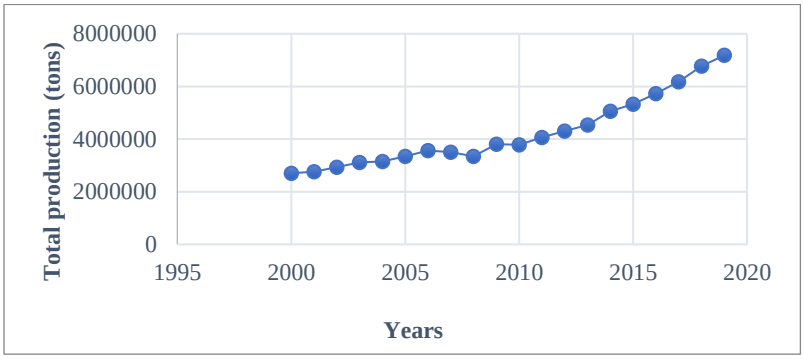
As an indirect effect, avocado can enhance vitamin absorption when consumed with vitamin sources such as carrots and tomatoes. In a study, the participants had four different diets. These were; carrot, carrot +avocado; tomato sauce, tomato sauce+ avocado. In both diets, avocado improved the absorption of Lutein, alpha-tocopherol (vitamin E), and Phylloquinone (vitamin K1) (Kopec et al., 2014).

1.3. Production and Trade

1.3.1. Production

Avocado production has increased tremendously in the last 20 years all over the world. The yearly production quantities more than doubled from 2000 to 2019 (Table 1.2). The total harvested area has also increased from 329,000 hectares (ha) to 726,000 ha in the last twenty years (FAO, 2019).

Table 1.2. Avocado production quantities throughout the world over years



Source: FAO. (2019). FAOSTAT. http://www.fao.org/faostat/en/#data/QC. -access: 14.07.2021

Mexico is the leading producer of avocado worldwide, with over 2 million tons capacity in 2019. It corresponds to over 30 % of the global production. The following countries are; the Dominican Republic, Peru, and Colombia having percentages of 9, 7,3, and 7,3, respectively. Only two countries from non-Americas are in the top ten. Indonesia and Kenya have a production capacity of 6,3 % and 4,9 %, correspondingly. Other significant actors outside of America in avocado production are Israel, China, Ethiopia, and Spain. Figure 1.4 displays the avocado producers globally (FAO, 2019).

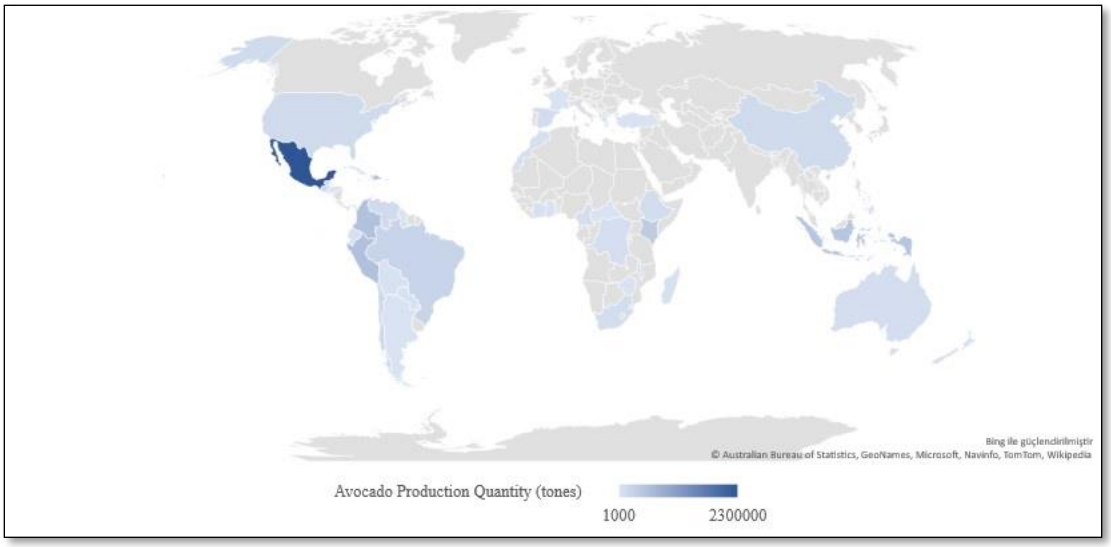


Figure 1.4 Avocado production in tons during 2019 (the countries on the map are having more than 1000 tons/year of production capacity)

Source: FAO. (2019). FAOSTAT. http://www.fao.org/faostat/en/#data/QC. -access: 14.07.2021

1.3.2. Trade

Figure 1.5 and Figure 1.6 represents top exporting and importing countries of avocado. The trade traffic information relied on International Trade Center (ITC) calculations based on United Nations International Trade Statistics Database (UN COMTRADE) statistics. Mexico is the most leading export country regarding avocados (FAO, 2019). Mexico exported 81 % of its avocado to the USA and 8 % of it to Canada. Peru is shipping most of its avocados to the USA, Spain, and the United Kingdom as the second-largest exporter of America. The third-largest exporter of the American continent is Chile. Chile has its markets mostly in Netherlands (42%), followed by

Argentina and China. The Netherlands, a non-producing exporter of avocado, imports avocado from largely Peru, Chile, Colombia, and South Africa and sells them to all European markets, mainly Germany and France. The United States, the top avocado importer (FAO, 2019), gets its 90 % avocado from Mexico. France, having the highest market volume of avocado in Europe (Centre for the Promotion of Imports, 2021), imports avocado from largely Spain, Peru, Chile, Mexico, and Kenya (ITC, 2020).

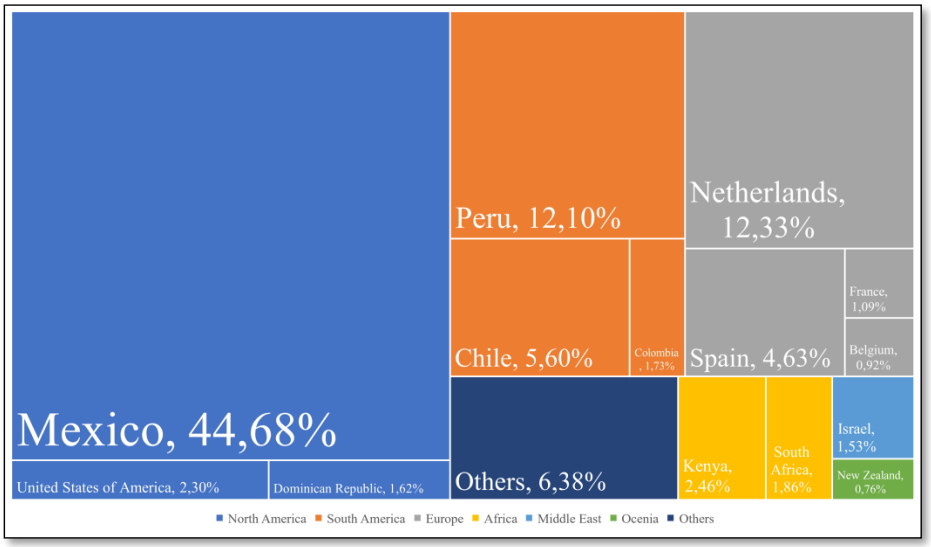


Figure 1.5. Top Exporting countries of Avocado **(**in terms of export quantity based on Food and Agriculture Organization official statistics FAOSTAT, 2019)

Source: FAO. (2019). FAOSTAT. http://www.fao.org/faostat/en/#data/QC. -access: 14.07.2021

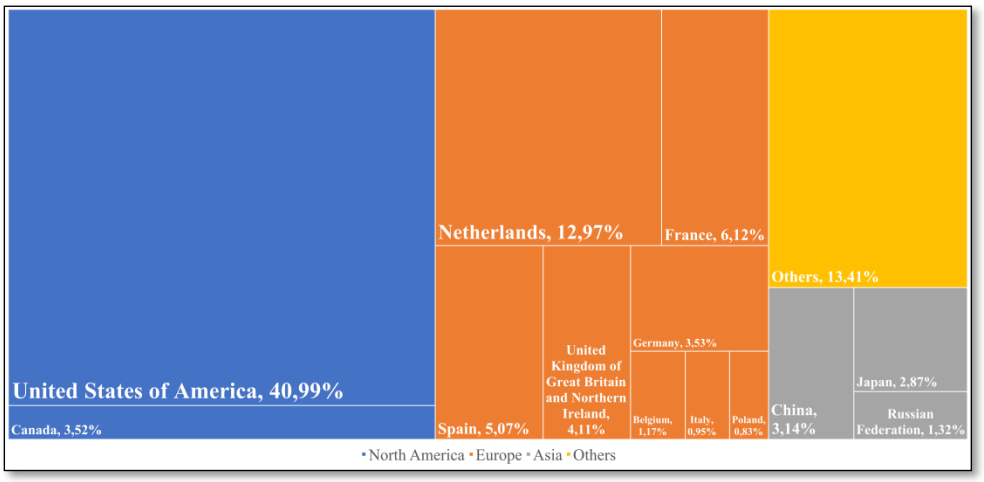


Figure 1.6. Top Importing countries of Avocado **(**in terms of import quantity based on Food and Agriculture Organization official statistics FAOSTAT, 2019)

Source: FAO. (2019). FAOSTAT. http://www.fao.org/faostat/en/#data/QC. -access: 14.07.2021

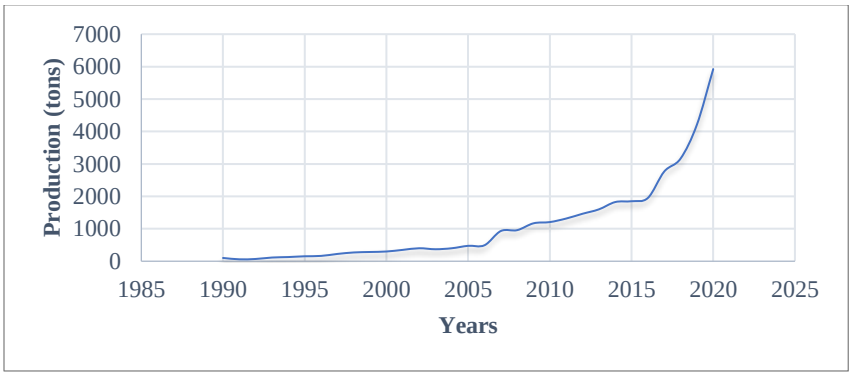
On the other hand, Turkey imports the majority of its avocado from Kenya (66%), followed by South Africa (%8) and Peru (%8). Turkey has the biggest market in Russia (20%) and Ukraine (20%), followed by Bulgaria, Romania, and Iraq (ITC, 2020). Export and import quantities of Turkey in 2019 were 681 and 2841 tons, correspondingly (FAO, 2019).

1.4. Avocado production in Turkey

First avocado production in Turkey dates to 1987 after FAO introduced it to the country for commercial trials. Batı Akdeniz Tarımsal Araştırma Enstitüsü Müdürlüğü (BATEM) (West Mediterranean Agricultural Research Center) conducted the commercial trials of avocado in the Mediterranean coast of Turkey. During the trials, BATEM evaluated, the avocado varieties, fruit specifications, yield efficiency, adaptation to requirements of the region, and market value. (Bayram, 2009). Turkey follows the general trend in increasing the production of avocado. Table 1.3 demonstrates the increase of avocado production through 30 years. Avocado production in Turkey increased slightly until 2006 (Table 1.3). Since 2006, the quantity of avocado produced has boosted considerably. While in 1990 annual production quantity was 100 tones, in 2006 it reached 492 tones with a slow rate of growth. However, in the last fifteen years, it raised more than tenfold

(TÜİK, 2021). Total lands with avocado orchards show parallelism with production quantity. While it was 146 ha in 2010, it reached 1264 ha at the end of 2020 (Özdal,2021).

Table 1.3. Avocado production quantities in Turkey over years



Source: TÜİK(Türkiye İstatistik Kurumu). (2021). *İSTATİSTİKVERİ PORTALI*. Türkiye İstatistik Kurumu. https://data.tuik.gov.tr/Kategori/GetKategori?p=tarim-111&dil=1. -access 16.07.2021

Avocado production in Turkey is exclusively on the Mediterranean coast, mainly in Antalya and Mersin. (Figure Table 1.7.) Antalya is the leading city in avocado production, accounting for a production capacity of 83,2 %. Mersin is in second place by a percentage of 14,7 %. Muğla contributes avocado production only 1,4 %. Hatay and Adana, the eastern Mediterranean cities, produce only 0,6 % and 0,1 % of the total quantity, respectively (Özdal,2021).

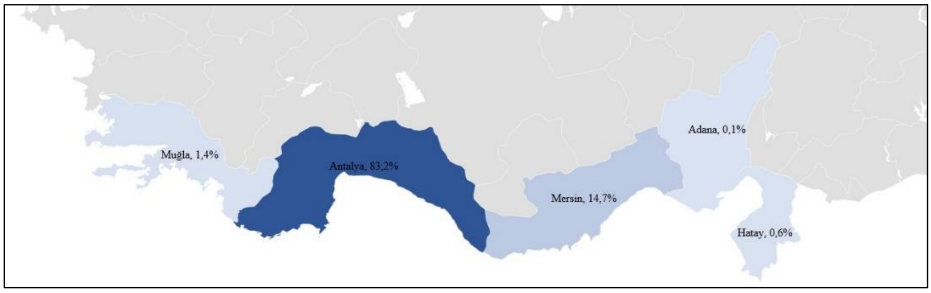


Figure 1.7. Avocado producing cities in Turkey

Source: Özdal, H. (2021). Tarım Ürünleri Piyasaları AVOKADO. T.C. TARIM VE ORMAN BAKANLIĞI TARIMSAL EKONOMİ VE POLİTİKA GELİŞTİRME ENSTİTÜSÜ MÜDÜRLÜĞÜ. -access 22.07.2021

The commonly used varieties in Turkey are Bacon, Hass, Zutano, Fuerte, Pinkerton Ettinger, and Wurtz **(**Bayram 2012b). Also, Demirkol investigated the yield and phenological characteristics of different varieties such as Clifton, Stewart, Blake and, Regina (Demirkol, 2002).

Bacon is a variety whose tree is growing vertically. It has good tolerance to cold temperatures up to -4,4 °C with the optimum harvesting period from November to December. One can store the fruits of this variety for up to 2 months at +4 °C (Bayram 2012b).

Hass, on the other hand, as the most common variety around the world, is very sensitive to cold temperatures. It is the variety with one of the most lasting harvesting periods compared to other ones, from February to June. The most significant characteristic of Hass variety is its high yield. A mature tree, 10-12 years old, can yield around 500 to 600 fruits in a year (Bayram 2012b).

Zutano is another variety tolerant to cold up to -3 °C. The fruits cannot stand for a long time on the tree after they grow mature. Thus, it has a short period of harvesting, November, and December. Pinkerton has rough skin like Hass, but it has a green color unlikely. The optimum harvesting period for Pinkerton is in January and February. Fuerte, the first commercially produced variety, has a harvesting time between December and April (Bayram 2012b).

The average yield of avocado cultivation in Turkey is 9,8 tones/ha. It is relatively lower when compared to other avocado producer countries such as the USA, Israel, and Mexico. The USA has the highest yield, 16,4 tones/ha, followed by Israel as 15 tones/ha. The average avocado cultivation yield in Mexico is 12 tones/ha, while Kenya has an average of 9,8 tones/ha. (Bender, 2017), (Imbert, 2018), (CIRAD, 2019), (Özdal, 2021), (Wasilwa et al., 2018). (Figure 1.8)

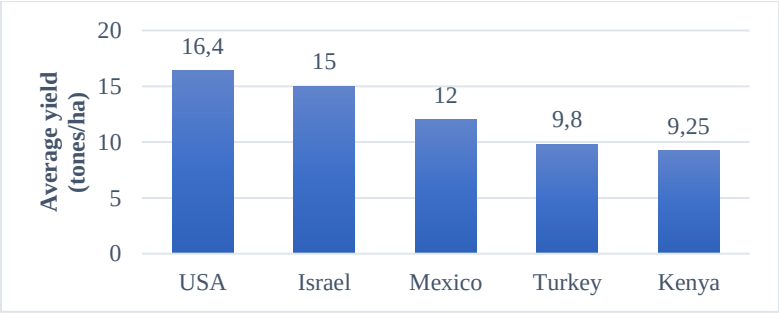


Figure 1.8. Average yield of some avocado producer countries

Source:Bender, G. S. (2017). Improvement of yield per acre by Close SPACING, pruning of Close-spacing 'hass' AND 'LAMB Hass' Trees, combined with NEW GROWER education classes final report. Improvement of Yield Per Acre by Close Spacing, Pruning of Close-Spacing 'Hass' and 'Lamb Hass' Trees, Combined with New Grower Education Classes Final Report | California Avocado Commission. https://www.californiaavocadogrowers.com/research-library/improvement-yield-acre-close-spacing-pruning-close-spacing-hass-and-lamb-hass-trees. Imbert, E. (2018). Producer country file the avocado in Israel. Fruitrop. https://www.fruitrop.com/en/content/download/44328/731161/version/4/file/F259+avocado+in+israel.pdf. CIRAD. (2019). 2019 country PROFILE: Mexico - HASS AVOCADO BOARD. Hass avocado board. https://hassavocadoboard.com/wp-content/uploads/2019/11/hab-marketers-country-profiles-2019-mexico.pdf. Özdal, H. (2021). Tarım Ürünleri Piyasaları Avokado. T.C. Tarim Ve Orman Bakanliği Tarimsal Ekonomi Ve Politika Geliştirme Enstitüsü Müdürlüğü. https://arastirma.tarimorman.gov.tr/tepge/Belgeler/PDF%20Tar%C4%B1m%20%C3%9Cr%C3%BCnleri%20Piyasalar%C4%B1/2021-Haziran%20Tar%C4%B1m%20%C3%9Cr%C3%BCnleri%20Raporu/Avokado,%20Haziran-2021,%20Tar%C4%B1m%20%C3%9Cr%C3%BCnleri%20Piyasa%20Raporu,%20TEPGE.pdf Wasilwa, L., Ochieng, V., Otipa, M., Amata, R., Oduor, B., & Omolo, P. (2018). Avocado cultivation . KALRO. https://www.kalro.org/sites/default/files/avocado-production-cultivation.pdf. -access 28.07.2021

1.5. Environmental concerns about avocado production

Environmental concerns about avocado production emerged due to some experiences around the world. Chile experienced an extremely dramatic water drought due to illegally installed pipes and wells for diverting water from rivers to irrigate avocado plantations (Facchini & Laville, 2018). Furthermore, avocado production has some impacts on forests leading 30-40 % of recent deforestation in Michoacán, Mexico (Mondragón & López-Portillo, 2020).

Avocado production depends upon a considerable amount of water if the growing takes place in dry regions. In such regions, the amount of water to grow one kg of avocado can be 320 liters at most. The average water requirement is about 280 liters. (Danwatch, 2020). Crop coefficients (Kc); are the values to relate the water use of a particular crop to a well-watered reference crop like grass (Piccinni et al., 2007). These values are the key elements for the calculation of evapotranspiration amount of the specific crops as following formula ETc = Kc x ETo where, ETc is the total water consumption of the crop, and ETo is the water consumption of the reference crop (Beyazgül et al., 2017). The average Kc value of avocado is 0,77, as it is 0,75 for watermelon, 0,7 for winter wheat, and 0,52 for olive that is produced in Alanya. Moreover, the average Kc value of avocado is 0,79, 0,74 for watermelon, 0,73 for strawberry and winter wheat, 0,54 for the grape produced in Anamur

(Beyazgül et al., 2017). Alanya and Anamur are the subprovinces of Antalya and Mersin, where most of the avocado is produced in Turkey.

The water footprint is the total amount of freshwater used directly or indirectly to produce this product. The blue water footprint attributes to the volume of surface and groundwater used to produce a good; the green water footprint is for rainwater consumed by the product. The gray water footprint is the volume of freshwater that can tolerate the pollutants considering actual water quality (Mekonnen & Hoekstra, 2010). Water footprint data relies on a dynamic water balance model in the framework of the CROPWAT concept. CROPWAT (Crop Water and Irrigation Requirements Program of FAO) is a computer program developed by Food and Agriculture Organization (FAO); to determine crop water and irrigation needs by considering soil, climate, and crop data (FAO, 2021). Table 1.4 indicates the water footprint data of avocado and some other fruits.

Table 1.4. Global average water footprint of the fruits

	Global average water footprint (m3/ton)			
Product Description	**Green**	**Blue**	**Gray**	**Total**
Apple	561	133	127	821
Avocados	849	283	849	1981
Bananas	660	97	33	790
Cherries	961	531	112	1604
Cranberries	91	108	77	276
Dates	930	1250	98	2278
Figs	1527	1595	228	3350
Grapes	425	97	87	609
Kiwi fruit	307	168	38	513
Mangoes	1314	362	124	1800
Pineapples	215	9	31	255
Strawberries	201	109	37	347
Watermelon	147	25	63	235

Source: Mekonnen, M. M., & Hoekstra, A. Y. (2010). The green, blue and grey water footprint of crops and ... Waterfootprint.org https://waterfootprint.org/media/downloads/Mekonnen-Hoekstra-2011-WaterFootprintCrops.pdf. access- 15.08.2021

There is a categorization for the countries according to their water assets. These categories include water-poor countries where per capita available water is below 1.000 m3; water shortage countries if this value is below 2.000 m; and water-rich countries if this value is above 8000 m3. For Turkey, this value is 1.519 m³ per capita (Öktem & Aksoy, 2014). Furthermore, precipitation has exhibited a downward trend in the last three years in Turkey (MGM, 2020). The precipitation quantities were 660 mm for 2018, 580 mm for 2019 and, 500 mm for 2020, respectively (MGM, 2020). Figure 1.9 represents the water stress level of the countries including, Turkey. According to this map, Turkey shows high water stress in some regions like West Mediterranean and Marmara. However, the water stress level is extremely high for the East Mediterranean part (Hofste et al., 2019).

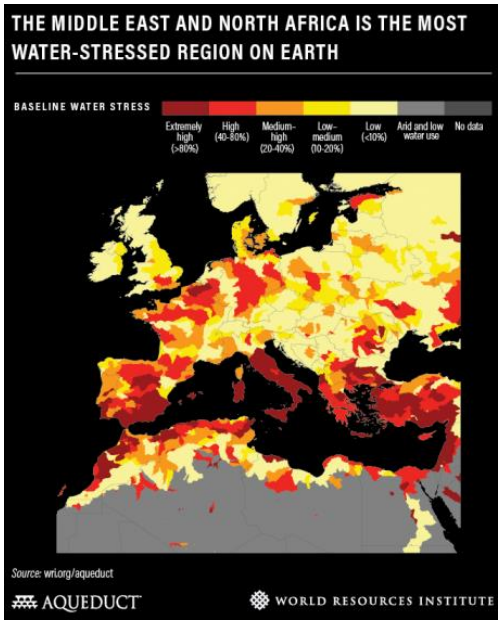


Figure 1.9. Water stress level of Middle East, North Africa and Europe countries

Source: Hofste, R. W., Reig, P., & Schleifer, L. (2019, August 6). 17 countries, home to one-quarter of the world's Population, face extremely high water stress. World Resources Institute. https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress. – access 17.08.2021

The amount of water used in the agriculture sector is 73% of the total water used in Turkey. 53% of the water used for agriculture sources from the surface waters, while 38 % is from

groundwater (Kahyaoğlu, 2015). The irrigation systems in the agricultural activities in Turkey comprise 83 % of basin flooding, 17 % of overhead irrigation, and 1% of drip irrigation (Kahyaoğlu, 2015).

The main driver of deforestation worldwide is agribusiness. It leads destruction of huge forest lands to make room for crops and livestock (Greenpeace, 2020). The estimated land size deforested for avocado production was 17,000 acres in Michoacán, Mexico (Earthside, 2019). Deforestation leads destruction of habitat and biodiversity loss (Greenpeace, 2020). Forests contribute several environmental benefits in the hydrological cycle, soil conservation, mitigation of climate change impacts, and conservation of biodiversity (Mondol et al., 2019). Any orchard or agricultural field cannot provide all of these benefits as the forests do. In Turkey, the law about forests does not allow to convert forests to farming areas even if they are destroyed (Orman Genel Müdürlüğü, 2020). Figure 1.10. shows the forest area change by country between 1990 and 2015.

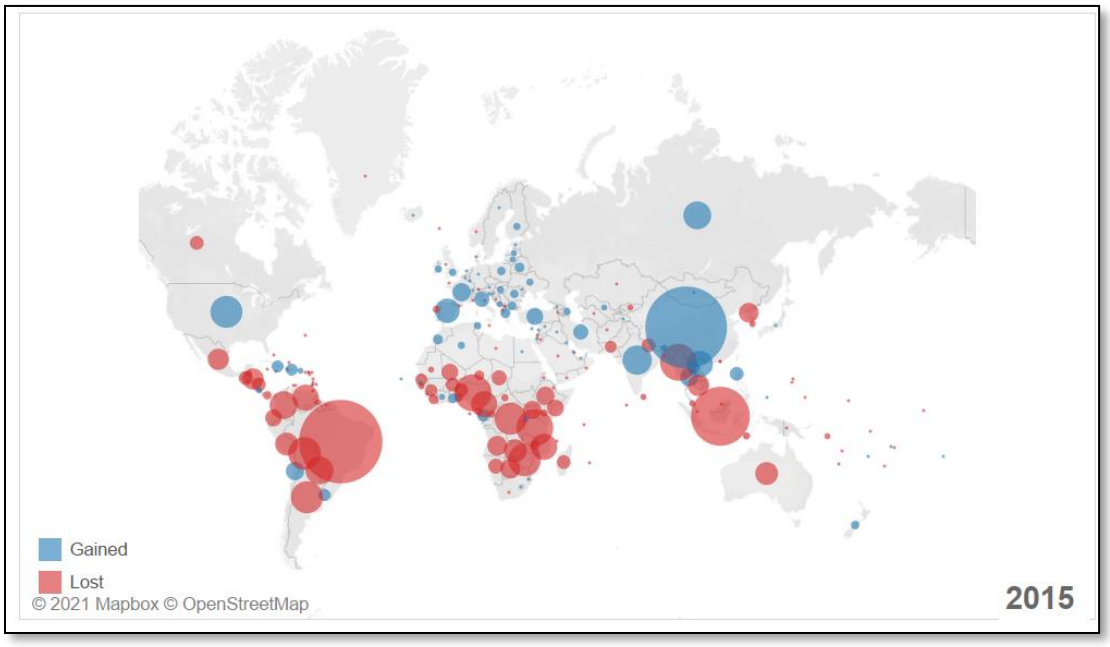


Figure 1.10. Change in forest area (km2) by country between 1990 and 2015

Source : World Bank. (2015). Five forest figures for the international day of forests. World Bank Blogs. Retrieved September 17, 2021, from https://blogs.worldbank.org/opendata/five-forest-figures-international-day-forests. -access 02.09.2021

Life cycle assessment is a method to evaluate environmental impacts related to a product and its life cycle. LCA involves all processes from gravel to the grave; raw material abstraction, production, distribution, and final use (Muralikrishna & Manickam, 2017). This method considers different environmental aspects. These aspects include resource depletion, acidification and eutrophication hazards, global warming potential, and the use of water resources (Martin-Gorriz et al., 2020). The researchers use mostly LCA software for the calculations (Hadjian et al., 2019). Hadijan et al did research to compute the LCA of avocado shipped from Mexico, the banana from Ecuador and, pineapple from Costa Rica to Europe. They investigated environmental aspects such as; agricultural land occupation, natural land transformation, water depletion, and climate change. For all the parameters, avocado had the highest impact.

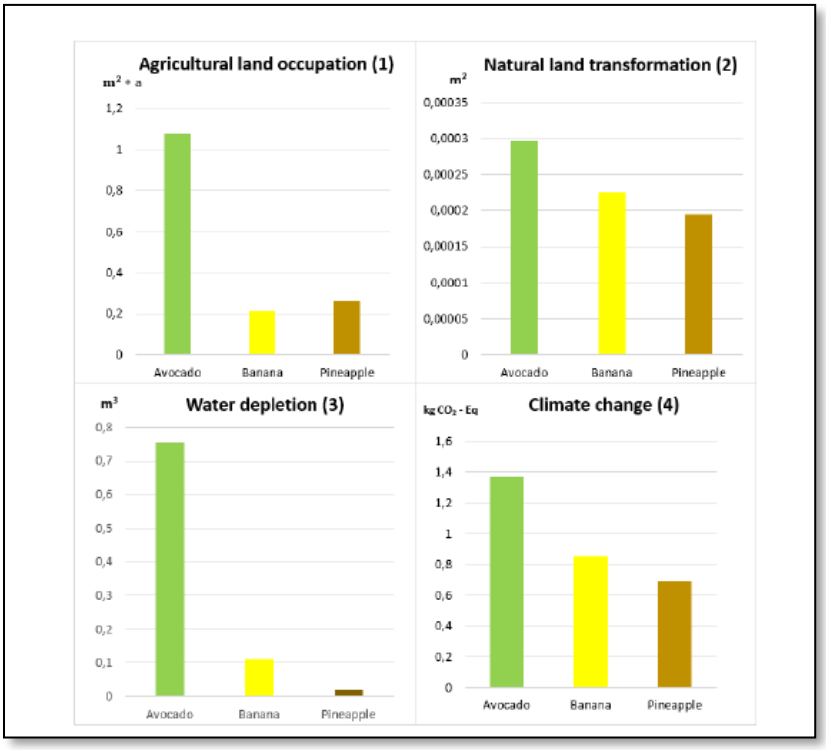


Figure 1.11. LCA comparison for avocado, banana and, pineapple

Source: Hadjian, P., Bahmer, T., & Egle, J. (2019). Life cycle assessment of three tropical fruits (avocado ... http://www.blog.industrialecology.uni-freiburg.de/wp-content/uploads/2019/03/LCA_tropical_fruits_Julian_Egle_Tobias_Bahmer_Peiman_Hadjian.pdf. -acces 25.08.2021

1.6. Objectives of the paper

Avocado is drawing attraction day by day by the people who are seeking a healthy diet and lifestyle. Due to increasing demand, growth, and exported quantities have rocketed for the last twenty years. Turkey also has the same scenario as the rest of the world regarding avocado growth and export numbers. Nevertheless, in 2018 a new awareness emerged about the environmental impact of avocado production. Chile experienced an extremely dramatic water drought due to illegally installed pipes and wells for diverting water from rivers to irrigate avocado plantations (Facchini & Laville, 2018). This situation brought socio-economic impacts. People living in this avocado production area could not access drinkable water and got sick (Facchini & Laville, 2018). Therefore, avocado production has some impacts on both water resources and residential social life. Moreover, it led 30-40 % of recent deforestation in Michoacán, Mexico (Mondragón & López-Portillo, 2020). This degradation may also affect the biodiversity of the forest land (Ayala, 2020).

In addition to environmental impacts that may ruin the reputation of avocado, as regarded as green gold, one should monitor the business risks of the new producers such as Turkey.

Thus, this paper aims a) to determine the economics of avocado production in Turkey, b) to assess environmental and business risks of avocado growers in Turkey, c) to recommend business strategies for farmers and policies to mitigate the detrimental effects of avocado production.

2. MATERIAL AND METHODS

2. 1. Research Design and data collection

A case study is a research methodology to understand better a complex phenomenon in its natural state (Heale & Twycross, 2018). It may contain a comprehensive and in-depth analysis of a specific incident, status, or community (Schoch, 2020).

Case studies can include single or multiple cases and several levels of analysis. They usually blend data collection techniques such as archives, interviews, observations, and questionnaires. The data may be either qualitative or quantitative, in some cases a combination of both (Eisenhardt, 1989).

This analysis included fifteen avocado growers in the Mediterranean region of Turkey. While five of the structured interviews were face to face, the rest were by phone call. I visited two growers in Alanya wholesales market. The first grower I met was not a random sample. He was the founder of the Alanya Avocado Producers Association. The second face-to-face interview was with a grower he directed me. The third face-to-face interview was with a grower in Gazipaşa that I reached by e-mail before. He was the one of two who responded to me positively out of eight attempts to have an interview. The final two face-to-face interviews were in Anamur. One of them was the president of Anamur Avocado Producers Cooperative. The other one was to rest on established connections via personal relationships. The phone call interviews, except one based on the contacts that I e-mailed before, were the connections of the growers that I met face to face. Most of the sample selection was dependent on a snowball method. I contacted fourteen avocado growers by phone call. Five of them refused to have an interview and the rest accepted. Five out of ten phone call interviews were with growers in Anamur, Mersin. One of them was with a grower in Erdemli, Mersin, that I contacted by e-mail and, four of them were with the growers in Alanya, Antalya. In Figure 2.1., the orange points represent the face-to-face interviews while the blue ones represent phone calls. Some are overlapped and not well-visible because of the resolution of the map.

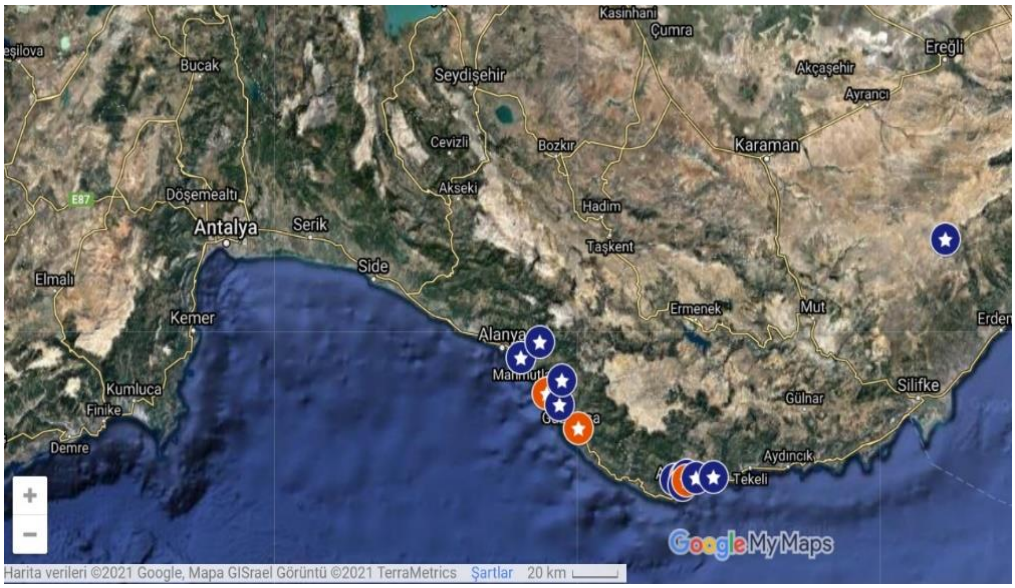


Figure 2. 1. Sample Selection (Created with GoogleMyMaps)

The interview questions were initially in English. I translated them into Turkish while using them. After translation into Turkish, I tested the questions with two people, one of them was an olive and almond grower and agriculture engineer, the other one was an engineer. They gave me feedback regarding some unopen statements that a farmer can misunderstand.

The interview questions comprised five different sections, which are:

- general questions about the farm,
- questions about risks regarding avocado growing in terms of production, business, and environment,
- questions about risk management
- questions about the resilience of the avocado growers.

Finally, there was a part related to the gross margin analysis.

General questions about the farm section consisted of both qualitative and quantitative data. This part had some open-ended questions to obtain qualitative data by unearthing farmers' personal experiences and understanding. Furthermore, there were multiple-choice, yes-no, and

Likert Scale survey questions to get quantitative data. The questions about risks, risk management, and resilience were in the form of 5-point Likert to reinforce qualitative data. (Table 5.1, Annex) The last part about gross margin contained qualitative data, as well. Gross margin data included gross income and variable cost data of the growers. Only face-to-face interviewees provided gross margin data.

The economics of avocado production in Turkey has been analyzed by use of gross margin budgets. The computed data about gross margin analysis were average, standard deviation minimum, and maximum values of the total value. Table 5.2. (Annex) contains the structure of the Gross Margin (GM) table. Moreover, gross margin ratio was calculated by dividing gross margin to gross revenue. This information was from five growers which I did interview face-to-face. The sales price, gross revenue, and gross margin values were the average values of those five. In GM tables, the raw data about the sales prices and costs were in Turkish Liras and converted to United States dollars at the current rate. Firstly, gross revenue was calculated by multiplying the selling price with yield. (Yield represents the total number of avocados that one grower produces.) By subtracting total variable costs from gross revenue, the gross margin was calculated. Mentioned variable costs were planting material, fertilizers, pesticides, irrigation, machinery, land rent, insurance, fuel-energy, taxes, overhead cost, and labor. Finally, the gross margin per hectare was calculated by dividing gross margin by total hectares.

Moreover, avocado growers stated any additional comments. Records were on hard copies were translated into English and transferred to Microsoft Excel workbook.

3. RESULTS & DISCUSSION

3.1. Economics of avocado production in Turkey

Avocado production is a promising commercial activity. The most important economic advantage of avocado production for the growers is to sell the fruits, not per kilogram but fruit. The second remarkable point is that avocado growing does not require high input costs.

According to Table 6.6. (Annex), the gross margin table, the minimum, the maximum, standard deviation, and the average value for gross revenue of five farmers are 22.113,02 USD,

118.081,18 USD, 35.377,85 USD and, 69.970,53 USD, respectively. The same parameters for total variable costs are 1.895,58 USD for minimum value, 9.169,74 USD for maximum value, 5.438,56 USD for the average and, 3.471,39 USD for standard deviation. Finally, the gross margin per hectare has a minimum value of 16.159,40 USD, a maximum value of 63.064,64 USD, a standard deviation of 26.411 USD and an average value of 43.142,59 USD. The average sales price of the growers was 0,64 United States dollars (USD) per avocado. The average annual gross margin value was 43.143,000 USD/hectare. Average gross revenue was 46.836,00 USD/hectare and average total cost was 3.693,00/hectare. Gross Margin Ratio was calculated according to following formula Gross Margin Ratio = (Revenue – Cost of Goods Sold) / Revenue (CFI Education Inc, 2020).

(46.836,00-3.693,00)/ 46.836,00= 0,92

Gross Margin Ratio = 92%

The gross margin ratio for avocado production in Turkey is 0,92, which is high. The gross margin ratio for double-density planted lemons in Australia is 0,39 (Citrus Australia, 2003), and 0,99 for dragon fruit, one of the most expensive fruits; produced in Indonesia (Hadi, 2017). Furthermore, gross margin ratios for banana production and citrus production in Turkey are, 0,69 (Atlı & Sahin, 2021), and 0,53 (Subaşı et al., 2016), respectively.

The gross margin raito value for avocados grown in the United States of America (USA) is 0,48 and, the selling price is 0.31 USD per pound which is 0,68 USD/kg, while it is 0,64 USD/avocado in Turkey. The pricing system in the domestic market differs between the two countries. That can be an explanation for the gap. The labor costs are close for both countries. While it is 2280 USD for Turkey, it is 3640 USD in the USA. Moreover, in the USA, the total labor cost is around 44% of total costs; this is 60% in Turkey. The reason for this the other input costs except labor are relatively lower in Turkey compared to the USA (Evans & Lozano, 2017).

While gross margin raito value 0,89 for avocado production in Argentina (Albino, 2016), it is 0,81 for avocado production in Mexico (Sánchez et al., 2018). (Comparison in Figure 3.1.)

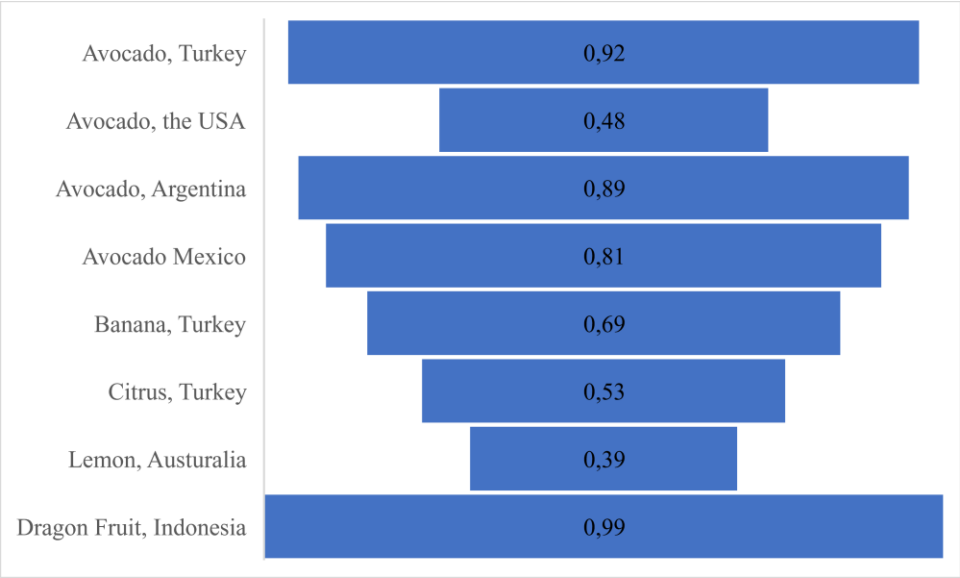


Figure 3.1. Comparison of gross margin ratio for different countries and products

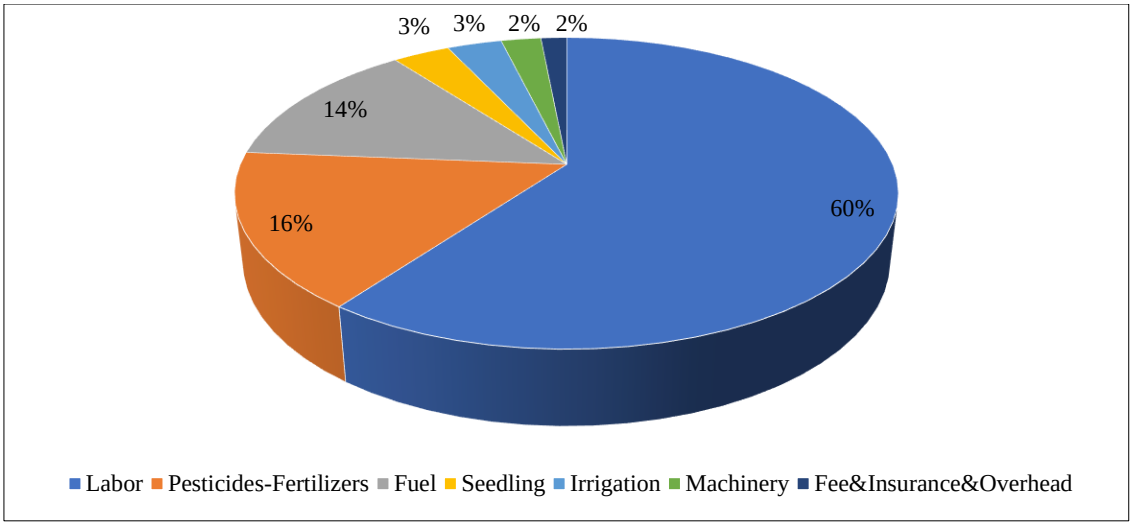


Figure: 3.2. Variable cost distribution of the avocado growers

Figure 3.2 indicates the variable cost distribution of the avocado growers. According to this graph, the highest cost item is labor since it is 60% of the total cost. The second highest cost item is plant protection products, namely pesticides and fertilizers by 16%. Fuel cost follows them with a percentage of 14. The remaining costs constitute the minority of total 10% which are, irrigation and seedling by 3%, and machinery and fee-insurance-overhead costs by 2 %, respectively.

The farmers generally were very content with the economic return of avocado production. They perceived avocado as a commercially valuable product. They considered avocado growing as maintainable, low labor and plant protection products required. 87% of the farmers evaluated the effect of avocado growing on their income as positive. Some farmers converted their citrus, plum, apricot, black mulberry, and olive orchards into avocado orchards. Moreover, the farmers' answers to resilience questions showed parallelism with the positive economic return of avocado production. In the resilience part (Table 3.1.), the questions aimed to measure the statements of agreement, ranging between 1 and 5. The questions had some categories. These categories included the following:

-willingness to innovate

-network potential

- ability to cope with the agricultural challenges

- resilience in terms of robustness, adaptability, and transferability

-future expectation and experience

Table 3. 1. Resilience of the farmers

			standard deviation	
	Resilience Questions	**average**		**mode**
I	I like to try out all kinds of new technologies and practices	4,25	0,97	5
N1	I am often in contact with nearby producers regarding production activities	4,17	0,72	4
F	For the following 5 years, I anticipate my orchard to be resilient to agricultural difficulties	4,00	0,85	4
Ra	After facing any challenge, it is easy for my farm to recover quickly	3,92	1,00	4

Rr1	In case of changes, I feel confident to adapt myself and deal with to agricultural challenges	3,92	0,67	4
Rr2	A great shock will not severely influence me, since I have enough alternatives to cope with this shock on my farm	3,50	1,24	4
Rt	In case of significantly change of external conditions, I am in trouble since it is difficult to restructure my farm	3,50	1,24	4
N2	I believe I can get help from agricultural authorities, experts, and important actors in my network	3,42	1,38	4
P	Considering last 5 years my orchard has often come across negative effects of agricultural difficulties	3,25	1,60	4
N3	Producers in my region tend to help each other in case of a problem	3,17	1,70	4
A1	I have the power to control agricultural difficulties affecting my orchard	3,17	0,94	3
A2	In my opinion, it is challenging to cope with problems that affect my orchard	3,08	1,24	3
A3	My orchard cannot adapt to cope with a changing environment	2,42	1,00	2

I: innovation, N: network, F: future expectation, Ra. resilience in terms of adaptability, Rr: resilience in terms of robustness, Rt: resilience in terms of transferability, P:past experience A:ability to cope with agricultural challenges

The statements *F*, *Ra*, *Rr1*, *Rr2*, in Table 3.6 were positive statements about the future expectations and resilience of the farmers. The average values of agreement degree for these statements were 4,00, 3,92, 3,92, and 3,5, respectively. That means the growers; mostly agreed that they were resilient about the future, robustness, and adaptability of their orchards. The statements *Rt* and *P* were the negative statements about resilience in terms of transferability and experience. The average values of agreement degree for these were 3,5 and 3,25, respectively. That implies the farmers were not resilient about transferability as much as other parameters. The

comparison of *Rf* to *Rp* suggested that although the farmers had some bad experiences in the past, they were more confident about the future. *A1* is a positive statement about the ability to handle agricultural challenges, while *A2* and *A3* were the negative ones. The average values of agreement degree were 3,17, 3,08, and, 2,42 respectively. That indicates the farmers mostly agreed on being capable of dealing with any agricultural challenges.

3.2. General outcomes of the interview

The age of the avocado growers ranged from 36 to 70 by an average of 53 years old, and they were all men. The average age of orchards was 9,1 years. The meters above sea levels of the orchards were generally below 300 m apart from two orchards above this. The average orchard size was 1,55 hectares having 406 avocado trees. The average number of avocado/trees/years was 343. The farming type was 20 % organic, and the rest was conventional farming. The high season for harvesting varies between September to January for most growers (Figure 3.3). None of the growers can harvest avocado in June and July since it is the end of the harvesting season.

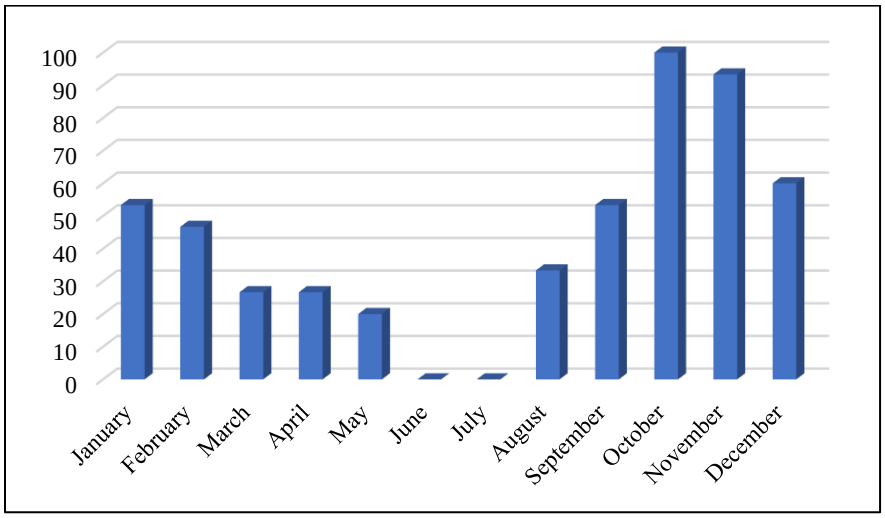


Figure 3.3. Percentage of farmers who can harvest avocado throughout the year

The question about the essential factors that led the growers to produce avocado had several answers. Ten out of fifteen growers stated that it was related to the commercial value of the product. Low labor and maintainability are the second frequent answers from the growers. Others are related to innovative thinking, the fruit's popularity, durability, having good taste, and being beneficial. Some growers began avocado growing on a friend's advice. One of them had a non-generic reason like the inherit of the orchard land (Table 3.2)

Table 3.2. Most frequent answers for the essential factors that led the growers to produce avocado

commercial value/added value product/good income statue	10
maintainability/low labor/low pesticide/inexpensive to produce	4
popular/in demand fruit	3
innovative thinking/future opportunities	3
friend advice	3
good taste/tropical fruit	3
durability	2
beneficial fruit	2
inherit of the orchard land	1

The perception of farmers about the effect of avocado growing on their income was 47 % incredibly positive, 40 % positive and, 13 % no effect. The sales channels of the farmers were twelve out of fifteen via wholesale, four via e-business, four via the local market, and two via farm gate sales. The level of satisfaction regarding avocado production was a 5-point Likert-type question. Ten of the growers stated their level of satisfaction as very satisfied, while the remaining five acknowledged it as satisfied. More than half of the growers were using drilling water for irrigation. The ones using open channel water were following them by 25 %. A few of them were using natural spring water and, one of them was using well water (Figure 3.4).

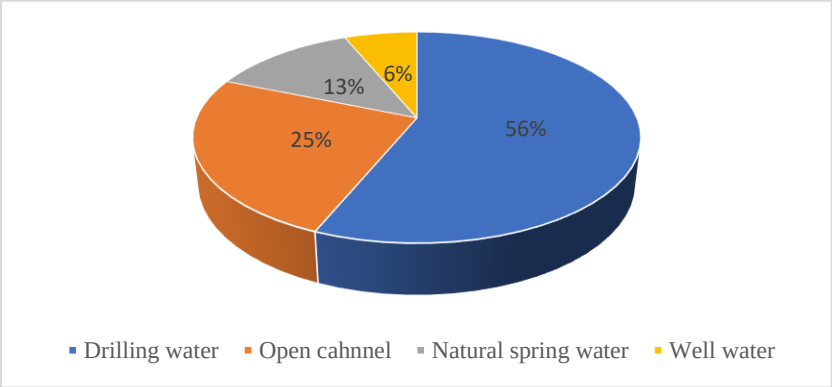


Figure 3.4. Percentages of water use type of avocado growers

Almost every farmer was using drip irrigation in their avocado orchards. Some of them also combined it with spring systems. None of them were using any technological application or program for the planning of irrigation schedules. The average water used for irrigation is 5610 t/year/ha.

Before avocado production, the vegetation covering the land where the place of current avocado orchards varied. A few of them were forest, limekiln, or empty. Most of the lands were citrus or other fruit orchards like plum, apricot, black mulberry, and olive. Moreover, some were agricultural fields like strawberry fields.

Almost all farmers had other agricultural productions as a financial activity. The most common alternative product was bananas followed by citrus products. Moreover, some of the farmers were growing other tropical fruits. Those were, mango, nagami kumquat, pawpaw, lime, passiflora, sweetsop, dragon fruit, cape gooseberry, carambola.

More than half of the avocado producers thought that avocado production was extremely environmentally friendly, while the rest thought it was very eco-friendly. Generally, they did not have any certificate like Good Manufacturing Practices or Global Gap certificate regarding their agricultural activities. About the production model, almost every farmer was producing their goods without any contract. Concerning production insurance, only four of the growers had agriculture insurance. Four of the farmers had a membership for any cooperative. Two of them were members of the chamber of agriculture. The other two were members of the Avocado Producers Association.

Most of the farmers did not have any information on exporting their products to European Union countries. One of them stated that there was not enough standardized yield for export. Another farmer acknowledged that export required some administrative obligations as being a legal entity and invoicing. However, their general opinion was that the domestic demand was sufficient for their products. Therefore, they do not need to export for the time being.

The most frequently stated disease was “root rot” due to fungal pathogens. The other disease factors they faced were a scab, acari, thrips, lace bug, red spider, armored scale insect, mites, sunburn, nematode, and rat damages.

The farmers provided additional comments about their experience as avocado growers. Farmer D stated that "The agricultural insurance does not generally cover hail and wind situations.” and “There is no sufficient product for export.” Farmer E stated that “There are some speculations about avocado related to its water demand.” Farmer F acknowledged that “The biggest problem is

brokers, they earn a lot without putting any effort." and "Water resources belong to the state. However, if they were private, the price uncertainty regarding water could occur." Farmer F expressed that "Generally, former citrus producers now tend to convert their production to avocado. The biggest problem is that there is no punishment for avocado robbery." Farmer H declared that "There is significant lack of information regarding young trees. The subsidies are insufficient." Farmer J stated that "If the water resources were private, this could be a huge problem for us." Farmer K had many comments. First, he expressed that "The most important problem is to supply high-quality seedlings, the newly orchards laid out have a low yield, the trees are in low quality, the yield per decare is too low", "I planted 400 trees and only 70 of them could be able to survive, everyone gets involved in seedling production since there is high demand. They produce hit or miss without any information", "We need to produce cloned rootstock. They produce it from the fruits and, then the yield becomes lower.", "While conventional tiller cost 15 Euros, cloned tiller price is 30-35 Euros with the same quality of the rootstock. It is forbidden to bring them to Turkey. However, we should have the know-how and, the state should produce or subsidy the production of cloned tillers." Farmer O stated that "Our consumers find imported avocado tasteless. When they face imported avocado on the market, their perspective of avocado changes, the consumers become biased."

3.3. Risk Analysis

3.3.1 Production risks

Table 3.2 shows the sources of the risks about production. The significant degree of the risks ranged between 4,58 and 1,42. For better understanding, the risk sources can be ranked as low, low to medium, medium, medium to high, and highly significant risks. (Table 3.3) According to the farmers, the production risk source having the highest significance was the strong winds with an average value of 4,58, the standard deviation was 0,51 and, the mode was 5. Fungi and sunburn followed it with the average values of 3,42 and 3,25, respectively. As a medium to high-risk source, sunburn, drought and, soil compaction stood. As medium-level risks, the growers determined; frost, hail, weeds, and wet conditions longer than forty-eight hours. Moreover, they considered salinity, rats, low temperatures, and birds as low to medium risk sources. Finally, the growers perceived that herbicide injury, physical damage during harvest, insects, and bats as low-risk sources.

Table 3.3. Production Risk Perception

	Risk Sources-Production	average	standard deviation	mode
HIGH	Strong wind/breeze	4,58	0,51	5
	Fungi	3,42	1,56	4
	Sunburn	3,25	1,36	4
MEDIUM TO HIGH	Drought	3,17	1,40	4
	Soil compaction	3,00	1,60	3
	Diseases	3,00	1,48	3
MEDIUM RISK	Frost	2,50	1,31	3
	Hail	2,33	1,07	2
	Weeds	2,33	1,15	2
	Wet conditions for 48 hours or longer	2,33	1,30	2
LOW TO MEDIUM	Salinity	2,25	1,42	2
	Rats	2,08	1,08	2
	Low temperatures	2,00	1,13	2
	Birds	2,00	0,74	2
LOW	Bats	1,92	1,51	1
	Insects	1,67	0,78	1
	Physical damage during harvest	1,42	0,79	1
	Herbicide injury	1,42	0,67	1

3.3.2. Business and export risks

The table 3.4. shows the risk perception of the farmers in regards of their business and export potential. While highly significant risks were robbery, change of agricultural policies and lack of information sources; the highest risk was supply uncertainty regarding export potential.

Table 3.4. Business and export risk perception

	Risk Sources-Business and Export*	**average**	**standard deviation**	**mode**
HIGH	Robbery	3,92	1,16	5
	Changes of agricultural policy	3,67	1,15	4
	Lack of information sources	3,67	1,50	4
	Supply uncertainty*	3,58	1,31	4
MEDIUM TO HIGH	Lack of farmers' cooperatives	3,33	1,44	3
	Lack of packing units*	3,25	1,29	3
	Certification requirements*	2,83	0,94	3
	High bargain power of processor-retailers	2,75	1,36	2
	Access to potential importers*	2,75	1,14	3
MEDIUM	Price variability	2,67	1,56	3

	Human health problem	2,67	1,37	3
	Lack of labor force	2,67	1,37	2
	Overseas competitors	2,67	1,23	2
LOW TO MEDIUM	Lack of contract growing	1,92	1,51	1
	High bargain power of input suppliers	1,83	1,03	1
	Credit availability	1,83	0,94	1
	Late collection of revenues	1,83	1,27	1
LOW	Transportation issues	1,67	0,98	1
	Changes in interest rate	1,50	0,90	1
	Access to market	1,00	0,00	1

3.3.3 Risk management strategies- Production, business and export

The risk management strategies included in the interview as in Table 3.5. According to this, water management, improved forecasts, security and safeguard systems, under-tree irrigation was the top five most significant risk management strategy.

Table 3.5. Risk management strategies

Risk Management Questions	**average**	**standard deviation**	**mode**

Water management	4,42	0,67	5
Improved forecasts	4,25	1,14	5
Security and safeguarding systems	4,00	1,13	4
Under-tree irrigation	4,00	0,60	4
Adopt new technology	3,92	0,90	4
Wind breaks	3,92	1,16	4
Strengthen farmers' cooperatives	3,92	1,31	4
Using technology for irrigation scheduling	3,83	1,34	4
Production diversity	3,50	1,00	4
Plant Protection products	3,25	0,97	3
Maintaining good relationship with ministry of agriculture	3,25	1,36	4
Assurance of bank loan	3,08	1,31	4
Off-farm income sources	2,92	1,16	3
Orchard insurance	2,92	1,31	3
Personal insurance	2,92	1,24	3
Training/consultation	2,92	1,51	4
Monitor salinity levels	2,75	1,29	3
Getting Inspection services	2,67	1,56	3
Anti-hail shade nets	2,50	1,45	3
Contract farming	1,83	1,40	1
Orchard heaters	1,33	0,65	1

For the strong winds, the best risk management strategy would be wind breakers. The farmers perceived it as a risk management strategy having a medium to high significance. Wind break plants are also beneficial to maintain biodiversity that may be lost in the case of monotype planting.

Fungi, the second most significant production risk, showed parallelism with the results of the most frequently faced disease, root rot. Root rot disease occurs due to poorly drained soil conditions and the presence of excessive soil moisture (Larum, 2021). For decreasing the risk of root rot disease, water management and under tree irrigation, stated as highly significant risk management strategies by the growers, is crucial. Using technological applications for irrigation was another risk management strategy to prevent root rot. However, none of the farmers were using such an application. Using an application for water management would be a beneficial method to avoid excessive water use and eventually mitigate the depletion of water sources. Since the farmers mostly agreed that they like to try out all kinds of new technologies and practices, they may follow this kind of management strategy in the future. For this, an initiating and leading authority such as institutions or universities is essential. Getting inspection services would be an option to manage related diseases. However, the growers saw this as one of the lowest significant risk management strategies.

In the literature, the way to prevent sunburn is using sunscreens. Alder, suggested that latex painting would protect the avocado trees against sunburn by forming an opaque coating. Moreover, he suggested shade nets for the young trees (Alder, 2017).

Drought was perceived as a medium to high risk by the farmers. Particularly during the summer months, irrigation is essential since avocado trees are water-dependent. However, due to climate change, farmers are now experiencing more drought compared to the past (Alauddin & Sarker, 2014). Therefore, drought-tolerant rootstocks seem a crucial management way to eliminate the detrimental effects of drought (Ben-Ya'acov & Michelson, 1995).

Soil compaction generally occurs due to pressure on the wet soil (Jenkins, 2004). Cover crops such as grasses, legumes, brassicas are valuable occasions to develop soil health in avocado orchards (UCANR, 2021a).

Plant protection products were regarded as a good way of managing diseases, weeds, and rats. Moreover, the majority of the farmers stated that, after the trees reach a certain amount of size, the weeds cannot take the sunlight and eventually die. That also explains why herbicide injury risk was evaluated as low risk.

The growers considered hail as a risk having a middle significance. However, it may cause super serious outcomes like no income through three years as experienced in Australia (Cavanagh, 2019). avocado growers in Turkey considered it a mild risk. The reason for this is related to the low probability of occurrence (MGM, 2014). However, improved forecasts can be a beneficial mitigation method for the hail. Moreover, hail shade nets are applicable and very useful against hail, sunburn, and wind damage (Sivakumar, 2017). The only drawback of that is, it may bring additional costs to the producers.

Agricultural insurance could be a favorable option to cope with climatic risks such as winds, hail, and drought. However, one of the growers stated that the agricultural insurance does not generally cover hail and wind situations.

Salinity was considered as one of the low to medium risks. Generally, it occurs in the soils excessively irrigated. Since the avocado growers in Turkey used drip irrigation, it is sensible that they do not face this problem often. However, this risk can be mitigated by monitoring salinity levels.

Low temperatures are also rare for the Mediterranean region of Turkey. The lowest temperature value during winter is 6°C in the Mediterranean region (Climate-data.org, 2020). That stood behind the growers evaluated low temperatures as low to medium risk. However, California University suggests using orchard heaters to have better protection during cold temperatures. However, the orchard heaters were the most insignificant risk management strategy according to the farmers.

The birds, bats and, insects were recognized as low to medium and low-risk factors. Since the financial damage due to these factors is below the economic loss threshold, the growers do not need to manage them (Bayram, 2012a). The growers stated that they seldomly faced physical damage during harvest. The picking person usually used a hook-style pole and managed to pick up the avocados with ease.

Avocado growing is a high-yield agricultural activity. Since the growers sell it as pieces but not kilograms, the profitability of the production is higher than the other goods sold as kilograms. Avocado producers in Turkey call avocado green diamond due to its high commercial value (Anka

Haber Ajansı, 2021). In other parts of the world, it is called green gold (Lema, 2019). However, this situation brings some threat to the producers. The growers become the main target of robbers. It is even worst in Mexico since it turned out to be an organized crime, the way behind simply stealing avocados. The growers in Mexico face assaults, kidnappings, hijackings, and even involvement in drug traffic (Lema, 2019). The growers also saw robbery as the most significant business risk. The level of the crime is not as organized crimes like in Mexico but as pickery at the moment. However, they started to experience it a lot since the avocado became popular. The main problem in Turkey is that there is no serious sanction regarding avocado robbery. Security and safeguarding systems are acknowledged as highly significant risk management strategies by the growers. However, even if they identified and caught the robber, the robbers are not punished in an intimidating way (DHA, 2021). A better strategy would be to have agricultural insurance inclusive of the robbery issues. The growers considered the orchard insurance as a low to medium significant risk management strategy. The minority of the growers, only four out of fifteen, had agricultural insurance. However, it would be good to have insurance with a full scope together with robbery. The avocado growers need to speak out about their needs regarding insurance or security issues as a union. Lack of farmers cooperatives was one of the medium to highly significant risks. Therefore, strengthening farmers' cooperatives is a crucial risk management strategy.

The other two highly significant business risks were changes in agricultural policy and lack of information sources. National associations such as Avocados Australia (Avocados Australia, 2017) or Hass Avocado Board in the United States have the power to contact ministries, institutes, and universities (Hass Avocado Board, 2021). They have the chance to fund research and development (R&D) programs and marketing for their production. Furthermore, they have education and training programs for the growers (Avocados Australia, 2017). In Turkey, such an organization is missing. Even if there are Alanya Avocado Association and Anamur Tropical Fruit Production and Marketing Cooperative; both are small-scale and local. For commercially strategic agricultural products like avocado, that kind of association could be achieved by the initiation of agriculture authorities. This way, avocado growers would have more voice against agricultural policy changes and lack of information sources. Moreover, it would be a strategy to have a good relationship with the Ministry of Agriculture and Forest to overcome these problems.

The high bargain power of processor-retailers was a medium to high ranked business risk for the growers. Most of the growers used wholesales as a sales channel. The growers need the retailers to put their goods on the market. This need might bring some advantages to the retailers over producers. If the growers have a national association as mentioned before, they will have power for determining both the selling price of their goods and the input supplies. This way, it would be easier to handle price variability as well.

Human health problems and lack of labor were seen as a medium-ranked business risk for the growers. Personal insurance, production variability, and off-farm income sources would be effective risk management strategies against this problem. Most of the growers had other productions such as citrus, banana, and other tropical fruits.

Overseas competitors were seen as a medium-ranked risk by the avocado growers. During the active harvesting season, almost all year except summer months, the goods on the market belong to domestic producers. The imported avocado enters the market only for a few months.

None of the avocado growers produced their products based on a contract. The reason for that is they do not have any problems finding the customer. Their production quantity is even under the domestic demand. That explains that they found contract farming as one of the highest insignificant risk management strategies. Late collection of revenues was ranked as low to medium risk. The avocado farmers mostly collected the payment in cash. There is also no obstacle in accessing the market. Accessing the market was the lowest significant business risk they had.

The avocado growers in Turkey did not have much interest in taking out loans from the banks for their business. That justifies that they saw credit availability and changes in interest rates as low to medium risk and low risk, respectively. Assurance of bank loans, a strategy for managing those risks, was seen as a mildly significant risk management option.

Transportation issues were considered as one of the lowest significant risks by the farmers. The retailers and wholesalers mostly got the goods at the farm gate.

The most significant risk about export was supply uncertainty. That means the amount of produced yield is not sufficient to fill the export trucks. That makes export unfeasible. The second significant risk was the lack of packaging units. The Netherlands has considerable amounts of ripening and packaging units for avocado (Centre for the Promotion of Imports, 2021). That makes the Netherlands one of the main actors for exporting avocado even though it is not an avocado-producing country. There were other risks which are certification requirements of the importing country and access to potential importers. The best way to handle these issues about export is to have a national association. This association should be responsible for collecting the considerable amount of supply, initiating establishing packaging units, contacting the importers, and providing R&D and training for standardized production practices that could be certified if needed.

3.3.4 Environmental risks and risk management strategies

The avocado growers in Turkey saw avocado production as an eco-friendly application. The degree of agreement on the statements about avocado production leads to environmental risks such as depletion of water sources, biodiversity loss, pollution, soil degradation, deforestation, and pesticide contamination was noticeably low (Table 3.4.)

Table 3.4. Risks about environment

Environmental risks	average	standard deviation	mode
Depletion of water sources	2,50	1,45	2
Bio-diversity loss	1,25	0,62	1
Pollution	1,00	0,00	1
Soil degradation	1,00	0,00	1
Deforestation	1,25	0,62	1
Pesticide contamination	1,25	0,62	1

Regarding the depletion of water resources, the avocado growers in Turkey stand in a good position since all were using a drip irrigation system that spends the minimum amount of water during irrigation. The suggested strategies for mitigation of water resources depletion were, water management, under-tree irrigation and, using technological applications for irrigation. However, there is another concern about water use in agriculture is illegal wells and drilling water. Drilling a well is under the authorization of the Directorate-General for State Hydraulic Works of Turkey (DSİ, 2021). Çağatay stated that there are hundreds of illegal wells to produce water-guzzling agricultural goods. These wells were in the depth of 300-500 meters. In the recent fifteen years, in many places, groundwater levels dropped below 150 m. The groundwater of the Konya plains has been depleted (Çağatay, 2021). Ağalar reported that there are three times more illegal wells than certified wells in the Konya plains (Ağalar, 2021). Most of the farmers in Turkey supply irrigation water from the wells that may threaten the sustainable level of groundwater. For this, the ministry of agriculture should increase the frequency of their controls. Moreover, criminal sanctions should be at a higher level for preventing people from drilling illegal wells.

Turkey, as a state is seemed to protect its current forests. The former intended purposes of avocado orchards in Turkey were generally agriculture. The lands were citrus, plum, and olive orchards in the past. To mitigate the risk of illegal deforestation, the Ministry of Agriculture and Forest should monitor the conditions of forests regularly.

The total environmental impact of goods depends on a lot of factors including the shipment distance. For this, shipment from closer suppliers would be an acceptable way to mitigate these effects.

Sustainable certification schemes are brand new practices to ensure the sustainability of the goods (Junior et al., 2016). Several sustainability standards have been constituted recently to focus on the environmental impact of products, social status and economic welfare of producers, and ethics (Muradian & Pelupessy, 2005). This type of certification scheme would be good strategy to keep under control the environmental damages of agricultural activities.

4. CONCLUSION

4. 1 Challenges and Limitations of the Thesis

One of the biggest challenges of the case study was to find potential interviewees since the growers were generally busy. Moreover, during the COVID-19 pandemic, it was hard to feel comfortable during the face-to-face interviews. During phone calls, there was a possibility of miscommunication that may avoid gathering accurate information. Finally, collecting data was a challenging experience for a person who has been involved in such research in the fields for the first time.

The main drawback of the thesis might be insufficient data for generalization due to the small sample size. That is followed by a lack of validation since the data was collected at a single point in time. The opinions, financial status, and perceptions of the farmers might show a change throughout time. Finally, although sustainability is a more comprehensive concept, covering social equity and ethics, in addition to economic and environmental regards, this thesis is limited to only economic and environmental ones.

4.2 Conclusions

The growers were very satisfied with the economic return of avocado production. They recognized avocado as a commercially valuable product and deemed avocado growing as maintainable, low labor and plant protection products required.

The gross margin ratio of avocado production in Turkey was higher when compared to other products. The input costs were low, while the sales price of avocado was high. The highest cost item was labor which was 60 % of the total cost. The average annual gross margin ratio value was higher than the avocado farmers' in other countries like Argentina and Mexico. That makes avocado growers in Turkey competitive in the world.

The growers: mostly agreed that they were resilient about the future, robustness, and adaptability of their orchards. However, they were not resilient about transferability as much as other parameters. Although the farmers had some bad experiences in the past about their orchards, they were more confident about the future. Eventually, they mostly agreed on being capable of dealing with any agricultural challenges.

The most significant production risks regarding avocado growing in Turkey were determined as high winds, fungi, and sunburn. On the other hand, robbery, changes in agricultural policy, and lack of information sources were the most significant business risks. Regarding export, supply uncertainty was designated as the most major risk. Although the farmers perceived that avocado production poses a relatively low risk to the environment, the most significant environmental risks were designated as depletion of water resources and deforestation.

For the high winds, windbreak plants were suggested as a risk management strategy. The windbreak plants also contribute to biodiversity. Shade nets and latex paints were the best strategies for avocado trees to eliminate the detrimental effects of sunburn. Orchard insurance is another strategy to mitigate such production risks. The root rot, caused by the fungi can be prevented by good water management practices and under-tree irrigation systems. Moreover, using technological applications to form an irrigation calendar was another risk management strategy for both fungi risk and depletion of water resources.

The robbery was the highest significant business risk. The risks management strategies to mitigate robbery risk were to be security and safeguarding systems and agricultural insurance. Moreover, strengthening farmers' cooperatives or unions was also crucial. That will enable farmers to collaborate and be more powerful. Thus, their involvement in regulating the sanctions for the robberies would be more practical.

Regarding the risks such as change of agricultural policies and lack of information sources, a national association of growers would be a beneficial strategy. Thus, avocado growers would have more voice against agricultural policy changes and lack of information sources. Moreover, the supply uncertainty, the most significant export risk, can be mitigated by standing together of the growers. Such an association can be established with the initiation of the Ministry of Agriculture

and Forest. Therefore, having a good relationship with the Ministry of Agriculture and Forest would be a legitimate strategy to overcome these problems.

Regarding the depletion of water resources, the avocado growers in Turkey stand in a good position since all were using a drip irrigation system that spends the minimum amount of water during irrigation. Moreover, water management systems, under-tree irrigation and using technological applications for irrigation were suggested to mitigate this risk. Still, there are risks of illegal wells. To eliminate this possibility, the Ministry of Agriculture should increase the frequency of its controls. Furthermore, criminal sanctions should be at a higher level for preventing people from drilling illegal wells.

The forests in Turkey are put under protection by law. Even if the forests are burned or destroyed, it is not allowed to convert them into agricultural fields. However, the Ministry of Agriculture and Forest should monitor the conditions of forests regularly.

To reduce the environmental impact of the products, shipment from closer suppliers would be an acceptable way. Moreover, the states should have crucial laws and policies to eliminate detrimental effects of agriculture on the environment regarding depletion of sources, deforestation, and water use. The other strategy would be to constitute certification schemes for sustainability. Consumers, growers, and government bodies should support this system to conserve our wealth.

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5. ANNEX

Table 5. 1. Interview Questions

Socio-demographic questions and questions about farm			
What is your age? **What is your gender?**	☐Female ☐Male	**The location and age of the orchard.**	
Is your farm conventional or organic?		**What is the size of your avocado orchard? How many hectares and how many trees?**	
How many of avocado is produced/tree yearly?		**How long is your production season?**	
What are the most important factors that lead you to produce avocado?	1. 2. 3.	**Do you think the effect of avocado production on your income is?**	☐Incredibly positive ☐Positive ☐Negative ☐No effect
How is the way of selling your product? **Please indicate percentage for each.**	☐ Local market ☐Farm gate ☐Wholesale ☐Production under contract ☐E-bussiness ☐Export ☐Other (…….)	**What is your level of satisfaction regarding avocado production?**	☐Very satisfied ☐Satisfied ☐Enough satisfied ☐Dissatisfied ☐Very unsatisfied
What kind of irrigation water do you use?	☐Well water ☐Municipal water ☐Recaptured water ☐Natural water ☐Other(……..)	**What is your irrigation type?**	☐Overhead ☐Drip ☐Subirrigation ☐Check flooding ☐Cablegation ☐Other(……..)

Do you use any kind of technological application to determine irrigation scheduling?		**What is the amount of water used for irrigation on average/year/ha?**	
Before avocado production, what kind of vegetation was covering the land where the place with avocado orchards right now?	☐Forest ☐Empty land ☐Citrus ☐Agricultural land ☐Other(……)	**Do you have other productions or/and other financial activities?** **Yes** **No**	If yes, please add details Name and number of ha e.g. Apple 5 ha _____ Sheep 100 heads
Do you think it is an eco-friendly application?	☐Not at all ☐A little ☐Moderately ☐Very Much ☐Extremely	**Do you have any certificate? If so, what is about?** **Do you have any insurance?**	
What is your production model?	☐Contracted ☐Not contracted	**Are you a member of any cooperative?**	
Risk questions			
Please rank the most important production risk in avocado production (scale from 1 not important to 5 very important	Frost 1 2 3 4 5 Hail 1 2 3 4 5 Strong wind/breeze 1 2 3 4 5 Drought 1 2 3 4 5 Sunburn 1 2 3 4 5 Soil compaction 1 2 3 4 5 Low temperatures 1 2 3 4 5 Insects 1 2 3 4 5 Rats1 2 3 4 5	**Please rank the most important risks of your production on environment?**	Water scarcity 1 2 3 4 5 Bio-diversity loss 1 2 3 4 5 Pollution 1 2 3 4 5 Soil degradation 1 2 3 4 5 Deforestration 1 2 3 4 5 Pesticide contamination 1 2 3 4 5

	Birds1 2 3 4 5 Bats1 2 3 4 5 Fungi 1 2 3 4 5 Weeds 1 2 3 4 5 Diseases 1 2 3 4 5 Physical damage during harvest 1 2 3 4 5 Wet conditions for 48 hours or longer 1 2 3 4 5 Herbicide injury 1 2 3 4 5 Salinity 1 2 3 4 5	
Please rank the most important risks of your business/export*?	Access to market 1 2 3 4 5 Price variability 1 2 3 4 5 Low bargain power of processor-retailers 1 2 3 4 5 Low bargain power of input suppliers 1 2 3 4 5 Credit availability 1 2 3 4 5 Changes in interest rate 1 2 3 4 5 Late collection of revenues 1 2 3 4 5 Robbery 1 2 3 4 5 Human health problem 1 2 3 4 5 Lack of labor force 1 2 3 4 5 Lack of farmers' cooperatives 1 2 3 4 5	Changes of agricultural policy 1 2 3 4 5 Transportation issues 1 2 3 4 5 Lack of information sources 1 2 3 4 5 Lack of contract growing 1 2 3 4 5 Overseas competitors 1 2 3 4 5 Supply uncertainty* 1 2 3 4 5 Lack of packing units* 1 2 3 4 5 Certification requirements* 1 2 3 4 5 Access to potential importers*1 23 4 5
Risk Management Strategies Questions		**Resilience Questions**
What extent do you agree or disagree with the following risk management strategies?1 is disagree and 5 is agree?		**What extent do you agree or disagree with the following statements?**

Security and safeguarding systems 1 1 2 3 4 5 Plant Protection products 1 2 3 4 5 Off-farm income sources 1 2 3 4 5 Production diversity 1 2 3 4 5 Contract farming 1 2 3 4 5 Orchard insurance 1 2 3 4 5 Personal insurance 1 2 3 4 5 Water management 1 2 3 4 5 Improved forecasts 1 2 3 4 5	Adopt new technology 1 2 3 4 5 (Anti hail shade nets Orchard heaters/wind breaks Under-tree irrigation Monitor salinity levels Tensiometer usage) Getting Inspection services 1 2 3 4 5 Training/consultation 1 2 3 4 5 Strengthen farmers' Cooperatives 1 2 3 4 5 Maintaining good relationship with ministry of agriculture 1 2 3 4 5 Assurance of bank loan 1 2 3 4 5 Using technology for irrigation scheduling	After facing any challenge, it is easy for my farm to recover quickly 1 2 3 4 5 A great shock will not severely influence me, since I have enough alternatives to cope with this shock on my farm 1 2 3 4 5 In case of changes, I feel confident to adapt myself and deal with to agricultural challenges 1 2 3 4 5 My orchard cannot adapt to cope with a changing environment 1 2 3 4 5 In case of significantly change of external conditions, I am in trouble since it is difficult to restructure my farm 1 2 3 4 5 I am often in contact with nearby producers regarding production activities 1 2 3 4 5 Producers in my region tend to help each other in case of a problem 1 2 3 4 5	I believe I can get help from agricultural authorities, experts, and important actors in my network 1 2 3 4 5 I like to try out all kinds of new technologies and practices 1 2 3 4 5 In my opinion, it is challenging to cope with problems that affect my orchard 1 2 3 4 5 I have the power to control agricultural difficulties affecting my orchard 1 2 3 4 5 Considering last 5 years my orchard has often come across negative effects of agricultural difficulties 1 2 3 4 5 For the following 5 years, I anticipate my orchard to be resilient to agricultural difficulties 1 2 3 4 5
What are the most important disease factors that you faced? **Do you think is there any decrease in your water reserves?** **Do you think the soil quality decreased throughout the years?** **Do you know what kind of requirements does your product should have to export to the EU?** **Any additional comment?**			

Table 5.2. Gross Margin Budget Template

Crop Gross Margin Budget Template

Date:	**Total area:**	**ha**	**Local Currency:**		**Exchange rate ($US):**	
	Description	**Unit**	**Quantity**	**Price/unit**	**Total value (LC)**	**Total value ($US)**
Gross income						
Main product						
By-product 1						
By-product 2						
Subsidy						
Variable costs						
Planting material						
Fertilizers (total)						
Pesticides (total)						
Other inputs						
Machinery - own						
Machinery - hired						
Land rent						
Insurance						
Interest charges						
Taxes						
Other						
Overhead costs						
Labor:						
Hired						
Own						
Total						
Actual						
Actual minus imputed						
Gross margin						
Per Hectare						

Table 5.3. Gross Margin Table with data

DATE:08-09.04.2021	DESCRIPTION	TOTAL VALUE ($US)								
		Farmer D	Farmer F	Farmer G	Farmer I	Farmer J	Average	St. Dev.	Min	Max
	Area (ha)	**1,30**	**0,60**	**2,00**	2,00	**1,50**	**1,48**	**0,58**	0,60	**2,00**
GROSS INCOME (MAIN PRODUCT AVOCADO)		**86240,79**	22113,02	**118081,18**	61992,62	**61425,06**	69970,53	**35377,85**	22113,02	**118081,18**
VARIABLE COSTS										
PLANTING MATERIAL	Seedling	**245,70**	0,00	**246,00**	442,80	**0,00**	186,90	**188,61**	0,00	**442,80**
FERTILIZERS (TOTAL)	Shadow Powder,Bordeaux Slurry	**368,55**	491,40	**307,50**	307,50	**614,25**	417,84	**133,01**	307,50	**614,25**
PESTICIDES (TOTAL)	Herbicide	**859,95**	61,43	**246,00**	1230,01	**61,43**	491,76	**527,10**	61,43	**1230,01**
IRRIGATION	Irrigation	**552,83**	214,99	**0,00**	0,00	**122,85**	178,13	**228,18**	0,00	**552,83**
MACHINERY - OWN										
C1	Pruning Shears	**12,29**	6,14	**6,15**	6,15	**6,14**	7,37	**2,75**	6,14	**12,29**
C2	Prunning Scythe	**36,86**	6,14	**6,15**	6,15	**6,14**	12,29	**13,73**	6,14	**36,86**
C3	Hook-Style Pole Pruner	**24,57**	12,29	**12,30**	12,30	**12,29**	14,75	**5,49**	12,29	**24,57**
C4	Spraying Machine	**43,00**	0,00	**49,20**	24,60	**24,57**	28,27	**19,24**	0,00	**49,20**
C5	Anchor	**6,14**	6,14	**6,15**	6,15	**6,14**	6,15	**0,00**	6,14	**6,15**

MACHINERY - HIRED	Ladle, Elevator	**184,28**	0,00	**0,00**	123,00	**0,00**	61,46	**86,89**	0,00	**184,28**
INSURANCE			0,00	**61,50**		**0,00**	20,50	**35,51**	0,00	**61,50**
FUEL-ENERGY	Fuel		491,40	**307,50**	738,01	**1474,20**	752,78	**512,27**	307,50	**1474,20**
TAXES	Fee	**18,43**	6,14	**61,50**	123,00	**0,00**	41,81	**51,35**	0,00	**123,00**
OVERHEAD COSTS	Internet Etc.		88,45	**0,00**	0,00	**0,00**	22,11	**44,23**	0,00	**88,45**
LABOR:										
HIRED	Prunning/Harvesting Labor	**429,98**	245,70	**1476,01**	6150,06	**1228,50**	1906,05	**2428,54**	245,70	**6150,06**
OWN	Maintenance Labor	**1474,20**	353,81	**0,00**	0,00	**5528,26**	1471,25	**2347,19**	0,00	**5528,26**
TOTAL COST		**4256,76**	1895,58	**2785,98**	9169,74	**9084,77**	5438,56	**3471,39**	1895,58	**9169,74**
GROSS MARGIN (GM)		**81984,03**	20217,44	**115295,20**	52822,88	**52340,29**	64531,97	**35815,49**	20217,44	**115295,20**
GM PER HECTARE		**63064,64**	33695,74	**57647,60**	26411,44	**34893,53**	43142,59	**16159,40**	26411,44	**63064,64**

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BIOGRAPHY

Özgün Ezgi Koç was born in Ankara, Turkey in 1990. She graduated from Middle East Technical University, Faculty of Engineering, Food Engineering department in 2014. She has been working in the Turkish Standards Institute for four years as a food auditor in the department for certification. She is competent in English at the B2 CEFR level. The test results were 7,5 for listening, 7,0 for reading, 5,5 for writing and, 6 for speaking. She has experience working in a multicultural environment. She is interested in music in an unprofessional way as a chorist and likes traveling, discovering, and meeting new people.